APPENDIX B

BACKGROUND COMPARISON FOR METALS

Inorganic chemicals were selected as COPCs for the Del Amo site risk assessment if they met two screening criteria: (1) the site-wide data distribution was identified as above background, and (2) the parcel-specific maximum concentration was above the non-ambient concentration breakpoint and a toxicity threshold. This appendix describes the background comparison used to identify the inorganic chemicals elevated above background concentrations for the site.

Two general approaches for background comparison are to compare the site data to data reflecting either (1) local conditions (i.e., on or near the site) or (2) regional conditions (e.g., Southern California). For metals CalEPA prefers that a local data set be used in the comparison and provides an approach for selecting a local ("ambient") data set and comparing it to site conditions. The analysis presented here uses a weight of evidence approach following the recommendations for evaluating distribution shape provided in the CalEPA methodology. As additional information, we also include a comparison of the site metals concentrations to the metals data from a well-known study on background metals concentrations in Southern California (CalEPA, 1996b).

Table B-1 presents the results of the background comparison for metals with respect to four criteria: (1) the results of the Shapiro-Wilk test for normality and lognormality, (2) the evaluation of the Quantile-Quantile plots ("Q-Q plots") which indicate the linear continuity of the fit of the distribution to either a normal or lognormal, (3) the coefficient of variation (CV) and range of values (given as the order of magnitude between the minimum and maximum values), and (4) the results of a non-parametric comparison to the regional background data set (the Wilcoxon Sign test).

The first 3 criteria are evaluated as discussed in CalEPA (1997). CalEPA (1997) states that ambient metals concentrations tend to follow a normal or lognormal distribution, with common metals such as aluminum, iron, calcium, and magnesium tending to be normally distributed, while trace metals tend to be lognormally distributed. Although the first three criteria provide related information about distribution shape, each focuses on different aspects of the distribution fit, and consideration of all these criteria (not just one) is recommended by CalEPA when evaluating whether non-ambient data are present or not. The fourth criterion does not reflect an assumption about distribution shape, but rather compares the site data set to regional background levels. Because of the unique and not necessarily consistent information provided by these four criteria, we considered all four criteria, using a weight of evidence approach to identify metals as above background for the purposes of COPC selection. A metal was identified as above background if two or more of the criteria indicated potentially non-ambient data within the expanded data set.

Each of the four criteria were evaluated as providing or not providing evidence for multiple populations (e.g., ambient vs. non-ambient) as follows. According to CalEPA, distributions

that contain multiple populations will generally fail the Shapiro-Wilk goodness of fit test for both normality and lognormality. Therefore, in this analysis, Shapiro-Wilk P values greater than 0.05 were considered to indicate good fits, P values between 0.03 and 0.05 were considered to indicate borderline fits, and P values lower than 0.03, were considered to provide evidence for the presence of multiple populations or concentrations that were above ambient conditions on the site. Data sets with low CVs were often fit well by both the normal and lognormal distributions. In these cases, the distribution with the highest P value was identified in Table B-1.

The second criterion was based on a graphical assessment of the distribution fit using Quantile-Quantile (Q-Q) plots (Figures B.1 – B.20). The Q-Q plots in Figures B.1 through B.20 also identify the P value from the associated Shapiro-Wilk goodness of fit test and show the fitted distribution (either normal or lognormal) graphed on top of the data histogram to assist in the interpretation of the Q-Q plots. Q-Q plots are constructed by plotting the sorted data against the quantiles of the best-fitting normal or lognormal distribution for the data. In these plots, data points should fall approximately along the 0-1 diagonal line if the distribution assumption is accurate (small deviations are to be expected and are not significant). Significant breaks or bends in the Q-Q plots indicate departures from the assumed distribution and suggest multiple populations or outliers. If the Q-Q plot of the data looked roughly linear, then the fit was classified as "ok" in Table B-1. Cases with apparent departures from the assumed distribution are classified in Table B-1 as either "B" (indicating one or more breaks or bends) or by identifying the number of potential outliers. The B classification was used in cases where the departures involved more than a few points, while the number of potential outliers was identified when only one to three points potentially fell outside the rest of the distribution.

The third criterion involves the comparison suggested by the CalEPA (1997) of the range and coefficient of variation of the data with the values typically displayed by ambient distributions of metals. CalEPA (1997) states that metals data drawn from just one population typically display a range of detected values of no more than 2 orders of magnitude, and a CV of no more than 1. If the range was over 2 orders of magnitude or the CV was greater than 1.0, the data were considered to be evidence suggesting multiple populations.

The fourth criterion uses the results of the Wilcoxon Two Sample test comparison of the site data to data from the regional background data set pertaining to Southern California. This analysis is also presented to provide additional information in identifying what metals are above background.

In surface soils, the Shapiro-Wilk test found a significant discrepancy with a normal and lognormal distribution fit for cadmium, chromium, manganese, nickel, vanadium and zinc. In general these discrepancies were corroborated by either or both of the Q-Q plot evaluation or

range and CV evaluation. These metals were also found to exceed regional background levels for Southern California with the exception of manganese for which background data were not available. Including manganese, these metals were identified as being present at the site at concentrations above background, and therefore remained in the COPC selection process. Although the Shapiro-Wilk test found that arsenic was fit well by a lognormal distribution, arsenic was identified as above background based on the bend apparent in the graphical evaluation and its CV of 1.3.

The remaining metals were identified as below background and screened out of the COPC selection for surface soils. The Q-Q plot for cobalt indicated a number of low precision samples that consisted of detections having the same value (possibly truncation of significant figures). The anomaly created by the horizontal spread of these points is obvious and results in an interference of the Shapiro-Wilk tests. However, based on a visual evaluation of the Q-Q plot, the fit for cobalt was classified as "ok". Because of the Q-Q plot assessment and the low range and CV, colbalt was excluded from the list of metals above background. Interference due to the low frequency of detections made the Shapiro-Wilk test also unreliable for silver and mercury in surface soils. Silver had 2 detections out of 15 samples, while mercury had 6 detections out of 15 samples. The ranges and CVs calculated from the data sets, as well as visual inspection of the Q-Q plots, implied that the underlying distributions had low skewness for silver and moderate skewness for mercury. In the case of mercury, the CV of 1.6 provided evidence for multiple distributions above ambient. However, the Wilcoxon test found no significant difference between the site and the regional background data sets for mercury and silver. Therefore, these metals were concluded to be within background and excluded from the COPC selection process.

The Wilcoxon test is robust to different distribution assumptions, and therefore it can provide approximate results even for cases where the distribution type is unknown. Therefore, the Wilcoxon Two Sample test was performed for silver and mercury. The Wilcoxon test indicated that both silver and mercury could not be distinguished from the background data set. The P values of the Wilcoxon test for these two metals are considered approximate due to their high frequency of non-detected values. However, because the detection limits of these data sets are relatively low, and very close to the detection limits of the associated background data set, the overall outcome of significance or non-significance is considered robust and reliable.

Results for shallow soils were similar but not identical to those for surface soils. Cadmium, chromium, copper, nickel, manganese, vanadium, and zinc were again identified above background due to their lack of fit to the two distribution types (i.e., Shapiro-Wilk P value < 0.03 and breaks or outliers in the Q-Q plot). Cadmium and vanadium also had data distributions which were significantly above the regional background level, while chromium, copper, manganese, nickel, and zinc had distributions for shallow soil that did not exceed

background even though their concentrations in surface soil alone did exceed background. Thallium was detected in 2 out of the 22 subsurface samples; however, these detected concentrations (11 mg/kg and 12 mg/kg) were well above the mean regional background concentration. Therefore, thallium was identified as above background for shallow soils on the site.

The remaining metals were well fit by normal or lognormal distributions, were not significantly above the regional background data set, and were therefore excluded from the list of metals above background. In the case of arsenic, the shallow soil data included many more low concentrations than the surface data. These low concentrations had the effect of linearizing the Q-Q plot. Therefore, arsenic was excluded from the list of metals above background for the shallow soil layer. In the case of silver and mercury, the P values of Wilcoxon test are again considered approximate due to the high frequency of non-detected values. However, because the detection limits of these data sets are relatively low, and very close to the detection limits of the associated background data set, the overall outcome of significance or non-significance is again considered robust and reliable.

In addition, the background analysis was used to establish concentrations that individual samples could be compared to in the EAPC selection process. Ambient versus non-ambient breakpoints were identified by evaluating the Q-Q plots in Figures B.1 through B.20 for the nine metals that were determined to have concentrations above background (See Section 3.4.1.1), with the exception of thallium for which there were only 2 detects. For thallium, the breakpoint was defined to be the mean of the regional background data. For the remaining metals, Q-Q plots were used to identify the breakpoint above which a second (non-ambient) population was indicated.

As mentioned above, Cal-EPA (1997) states that "if data are drawn from just one population, the plot will be a straight line. If multiple overlapping populations are present, the plot will produce a gentle curve instead of a straight line. Gaps or inflection points in the plot (e.g., nonlinearity) suggest multiple populations, including possible outliers." CalEPA guidance (1997) further explains that "ambient conditions are defined as the range of concentrations associated with the population nearest the origin" and that this definition may be performed by inspection. Using only the data from the population nearest the origin of the Q-Q plot, a breakpoint value was selected which represents the upper range of the distribution.

The breakpoints are as follows: arsenic (10 mg/kg), cadmium (2 mg/kg), chromium (60 mg/kg), copper (150 mg/kg), manganese (450 mg/kg), nickel (25 mg/kg), thallium (0.3 mg/kg), vanadium (65 mg/kg) and zinc (170 mg/kg). Figures 7 and 11 highlight each sample location where the concentration exceeded both the ambient/non-ambient breakpoint and the residential soil PRG.

TABLE B-1
Evidence for Sitewide COPC Status for Metals
Baseline Risk Assessment
Del Amo Site

	Surface Soils (0-1')					Shallow Soils (0-15')			
Metal	Best Distribution (P value)	Q-Q Plot Evaluation (for Best Distribution)	Range (o.m.)/CV	Comparison to Southern California	Metal	Best Distribution (P value)	Q-Q Plot Evaluation (for Best Distribution)	Range (o.m.)/CV	Comparison to Southern California
Ag	[1]	[1]	0.8/0.9	n.s. (0.16) [2]	Ag	[1]	[1]	0.8/0.9	n.s. (0.09) [2]
Al	N(0.58)	ok	0.3/0.2	NA	Al	N(0.24)	ok	0.4/0.2	NA
As	L(0.16)	B	1.3/1.1	n.s. (0.7)	As	BL(0.04)	ok	1.7/1.4	n.s. (0.99)
Ba	L(0.29)	ok	0.2/0.2	n.s. (0.43)	Ba	N(0.23)	ok	0.4/0.2	n.s. (0.4)
Be	L(0.16)	1 outlier	0.3/0.2	n.s. (0.14)	Be	L(0.41)	ok	0.8/0.3	NA
Ca	L(0.68)	ok	0.7/0.5	NA	Ca	L(0.12)	0	0.7/0.5	NA
Cd	none	B	0.2/0.1	greater (0.00)	Cd	none	B	1.5/0.5	greater (0.00)
Co	none[3]	ok	0.1/0.1	NA	Co	BL(0.05)	ok	0.3/0.1	n.s. (0.19)
Cr	none	1 outlier	1.2/1.6	greater (0.03)	Cr	none	1 outlier	1.4/1.5	n.s. (0.14)
Cu	L(0.17)	B	1.1/0.9	greater (0.00)	Cu	none	B	1.2/1.1	n.s. (0.06)
Fe	BL(0.04)[3]	ok	0.1/0.1	NA	Fe	L(0.38)	ok	0.4/0.2	NA
Hg	[1]	[1]	1.4/1.6	n.s.(0.95) [2]	Hg	[1]	[1]	1.4/1.6	n.s. (0.99) [2]
K	L(0.84)	ok	0.3/0.2	NA	K	L(0.78)	ok	0.5/0.3	NA
Mg	L(0.94)	ok	0.3/0.2	NA	Mg	L(0.08)	ok	0.4/0.3	NA
Mn	none	B	0.3/0.2	NA	Mn	none	B	0.4/0.3	NA
Na	L(0.82)	ok	0.6/0.3	NA	Na	L(0.52)	ok	1.2/0.8	NA
Ni	none	B	0.7/0.6	greater (0.01)	Ni	none	B	0.8/0.5	greater (0.02)
Pb	L(0.5)	ok	1.6/1.3	n.s.(0.66)	Pb	L(0.14)	ok	2.1/1.6	n.s. (0.99)
Tl	[4]	[4]	[4]	[4]	Tl	[1]	[1]	0.6/0.6	greater (judgment)
V	none	2 outliers	0.7/0.7	greater (0.03)	V	none	2 outliers	0.4/0.3	greater (0.04)
Zn	none	1 outlier	1.1/1.1	greater (0.03)	Zn	none	1 outlier	1.2/1.1	n.s. (0.73)

Identified as above background and a potential parcel-specific COPC.

Evidence for concentrations above background.

[1] Low frequency of detections precluded test.

[2] Low frequency of detections makes test approximate.

[3] Low precision samples make test approximate.

[4] No detections in surface soil.

Best Distribution

N: Normal (P value > 0.05).
BN: Borderline normal (P value = 0.03 to 0.05).
L: Lognormal (P value > 0.05).
BL: Borderline lognormal (P value = 0.03 to 0.05).

Q-Q Plot Evaluation (Figures B.1 - B.20):

ok: Good fit, no or minor departures from linearity.
B: Breaks in linearity or curved pattern.
1 outlier: Number of outliers apparent in otherwise linear graph.
NA: Background data set not available.

Comparison to So. California

greater: Site data are significantly greater than background (P value <= 0.05).
n.s.: Site data are not significantly greater than Background (P value > 0.05).
(0.8): P value from the Wilcoxin Two Sample Test.
(judgment): Result concluded based on judgment.

Figure B.1
Shapiro-Wilk Distribution Tests for Aluminum
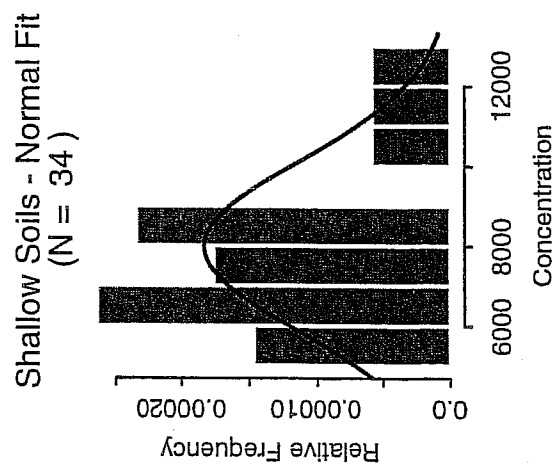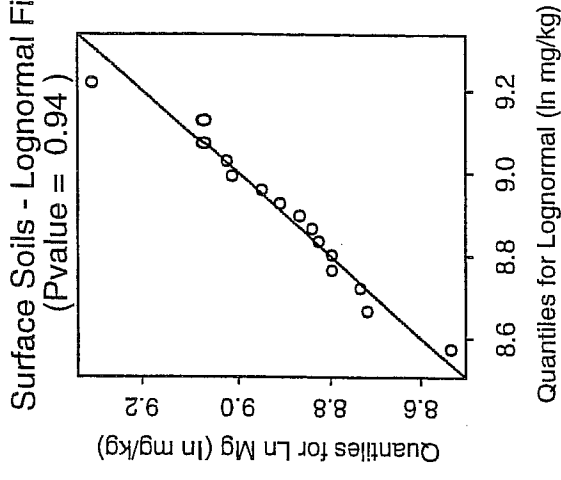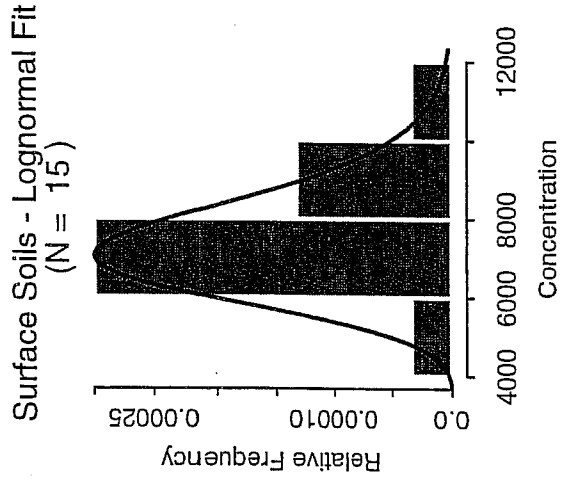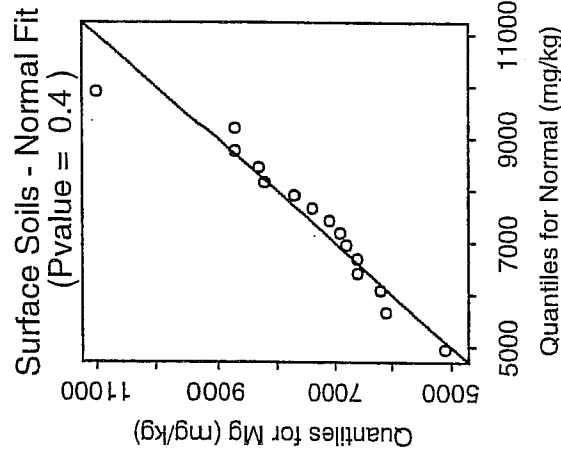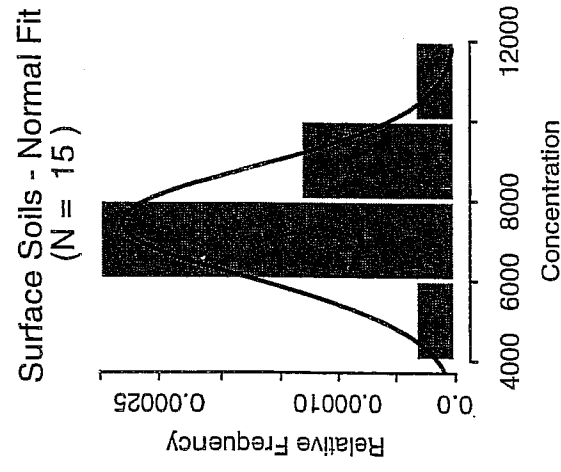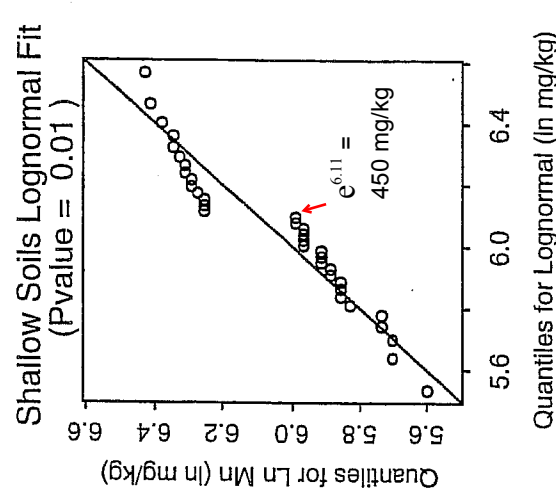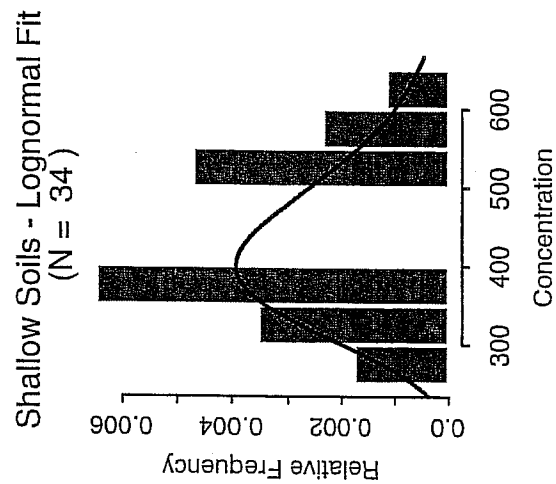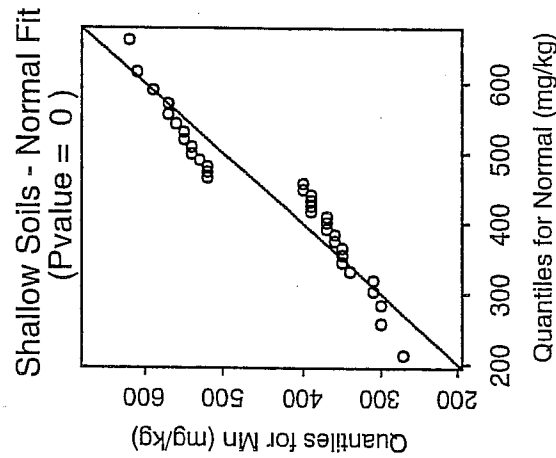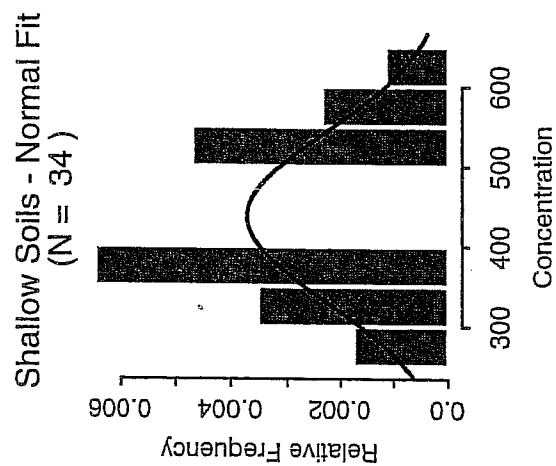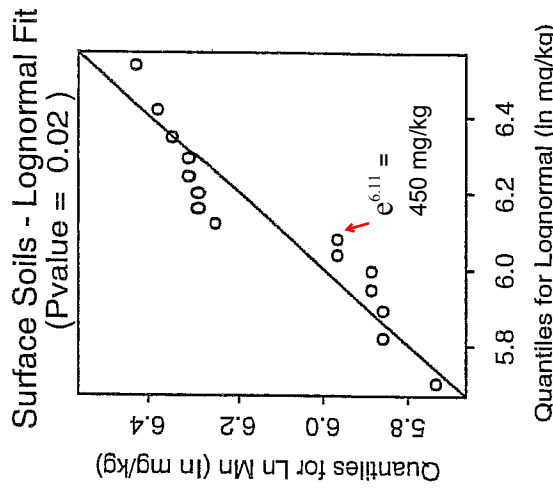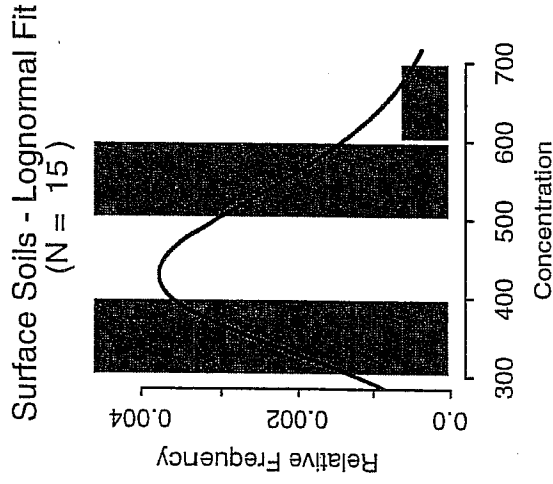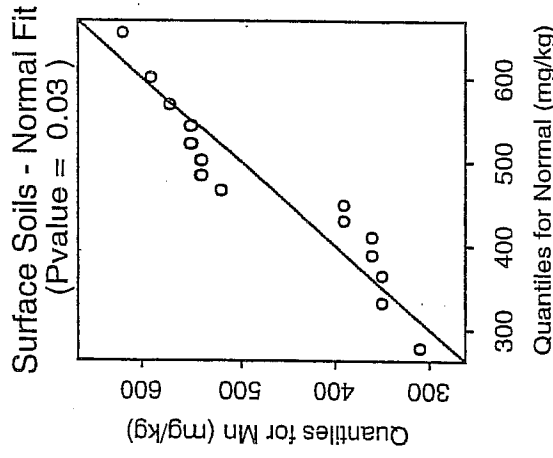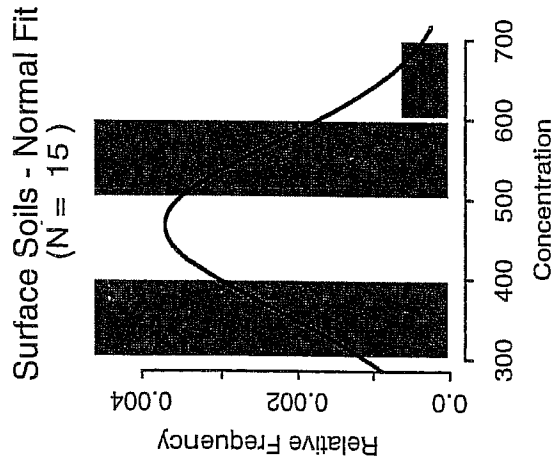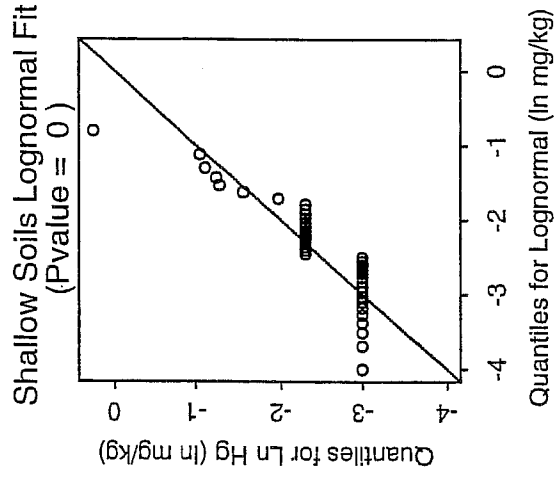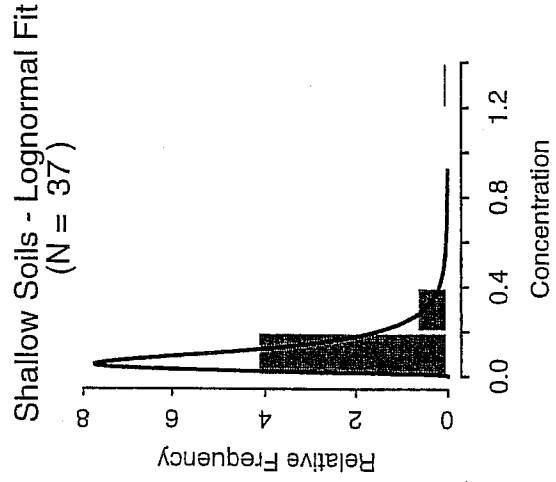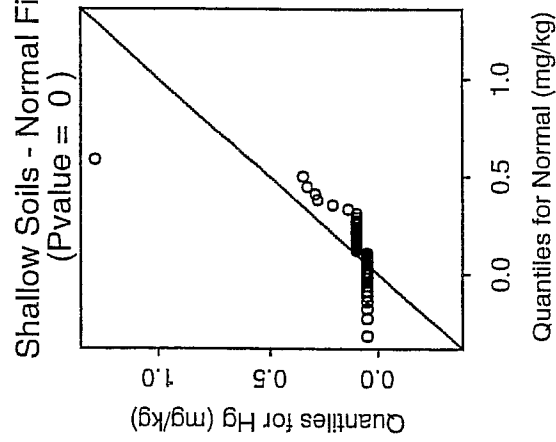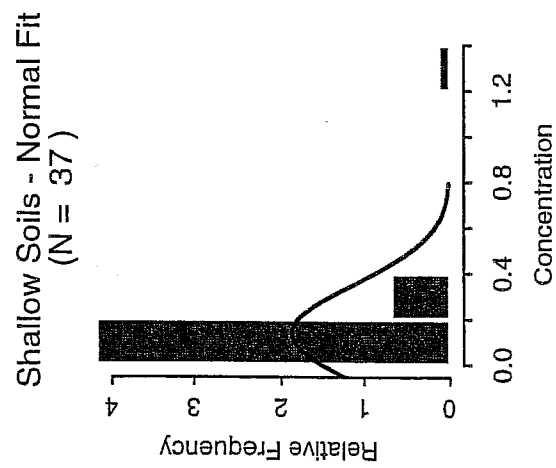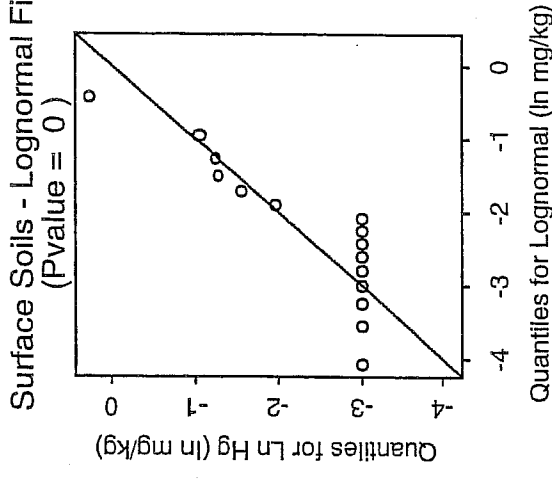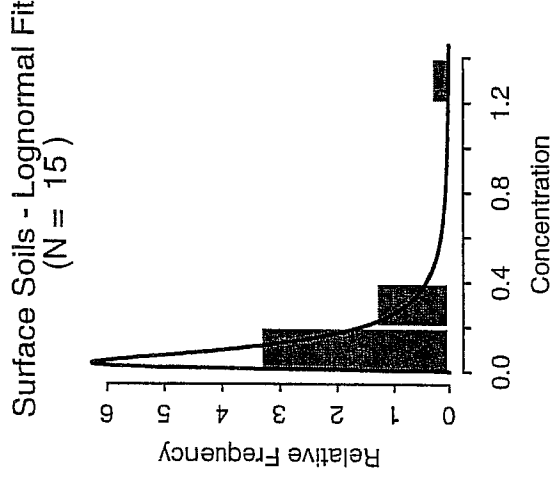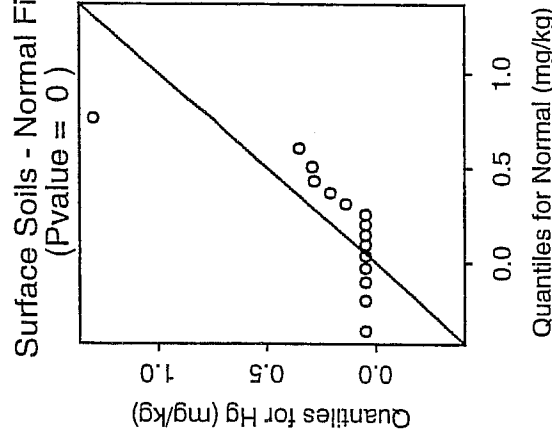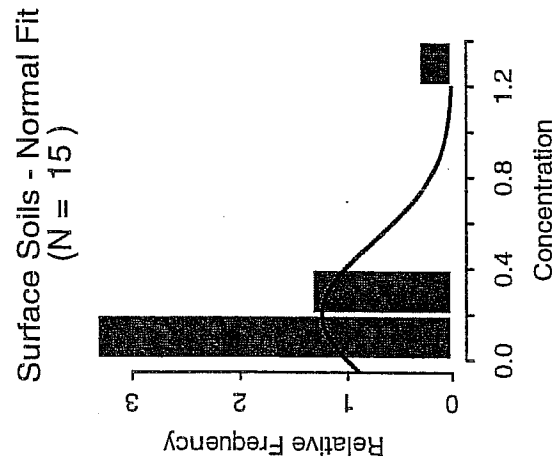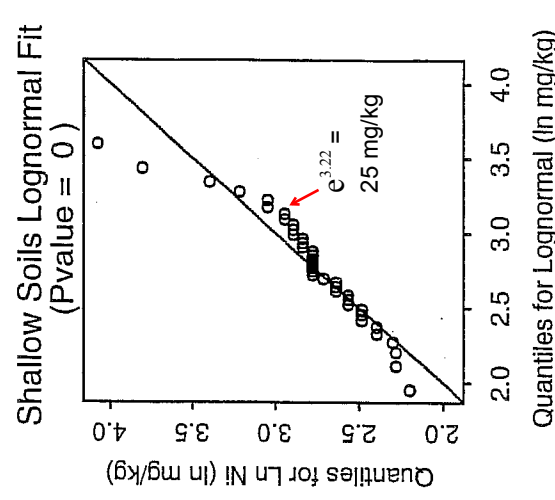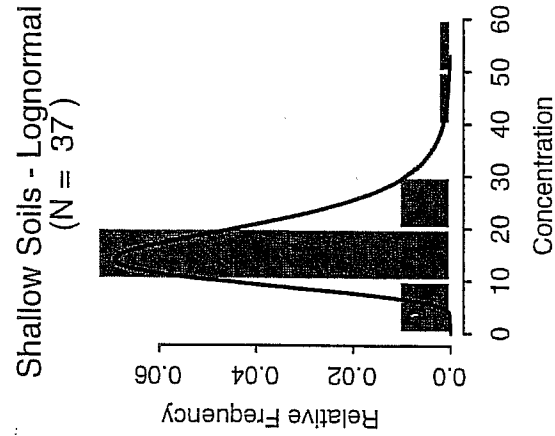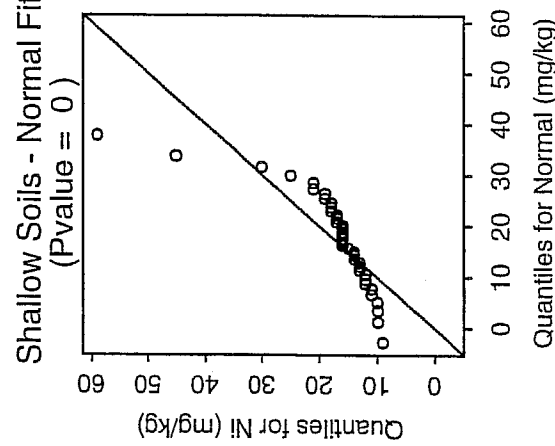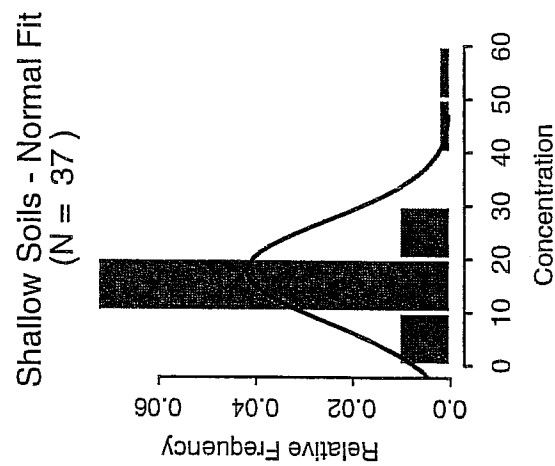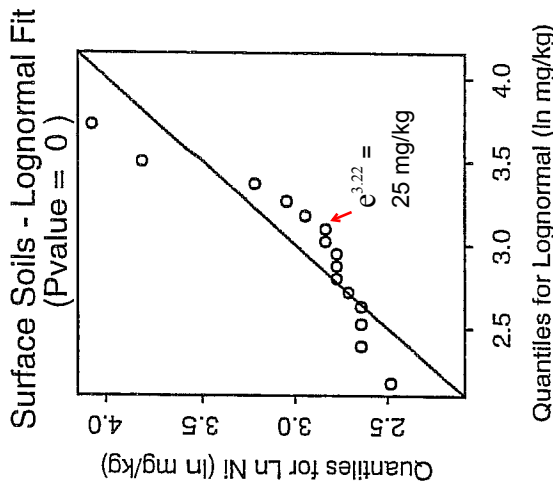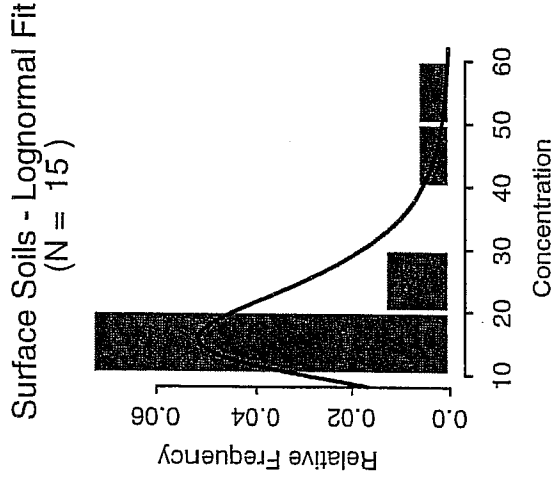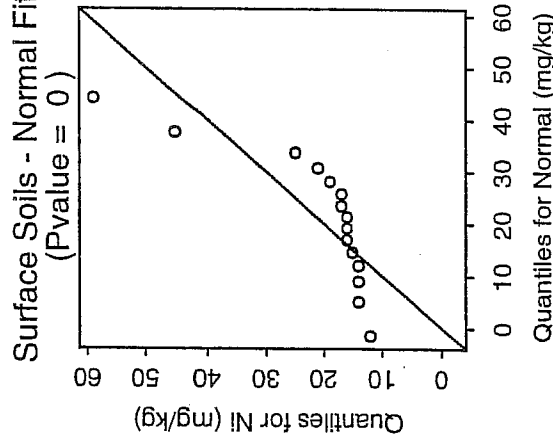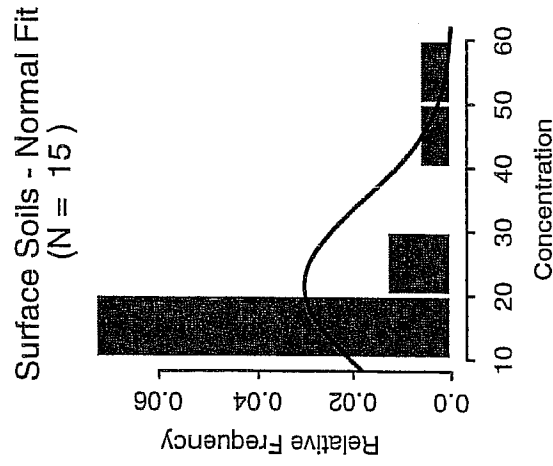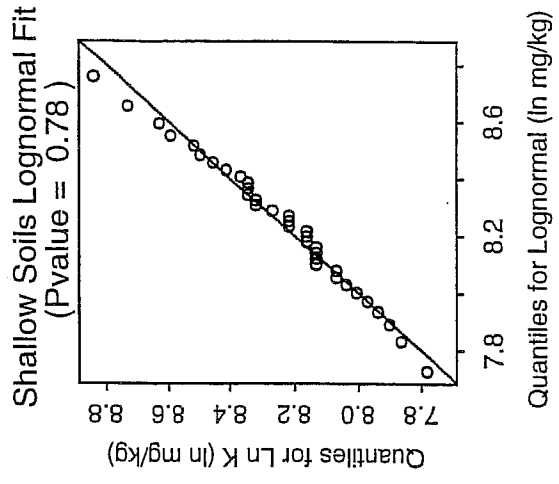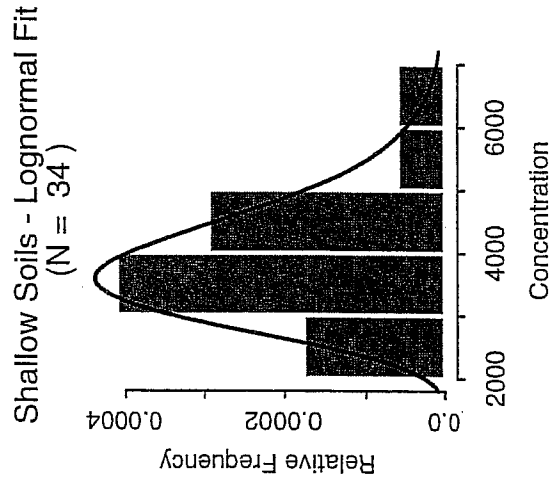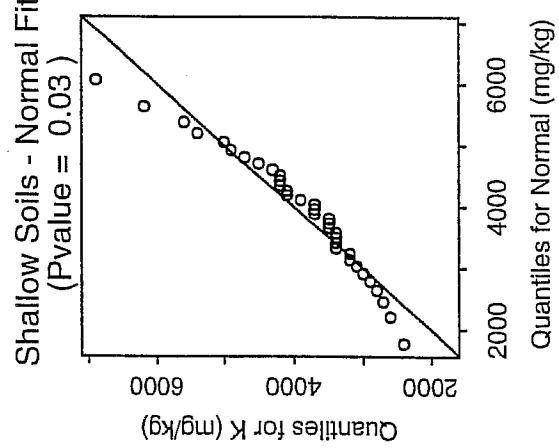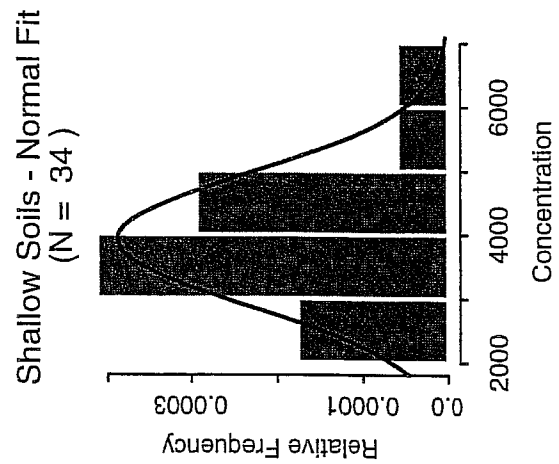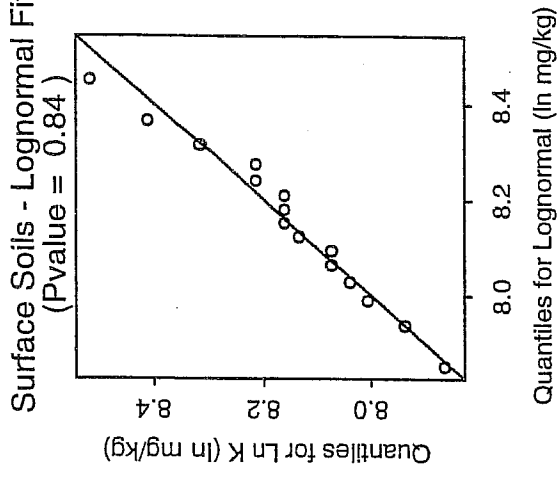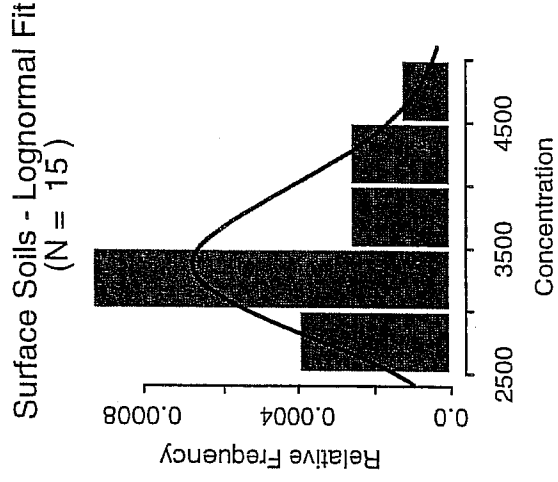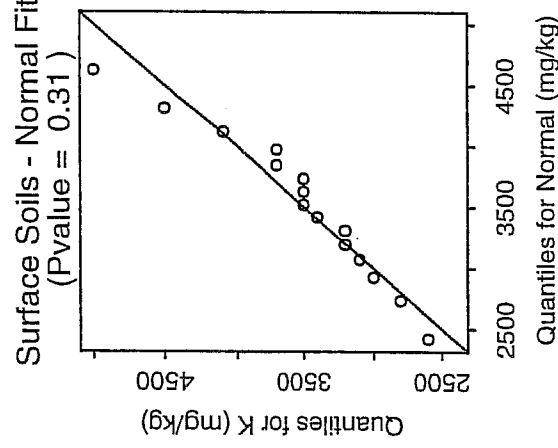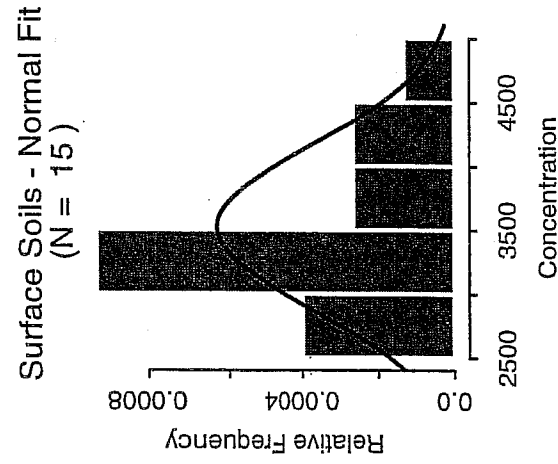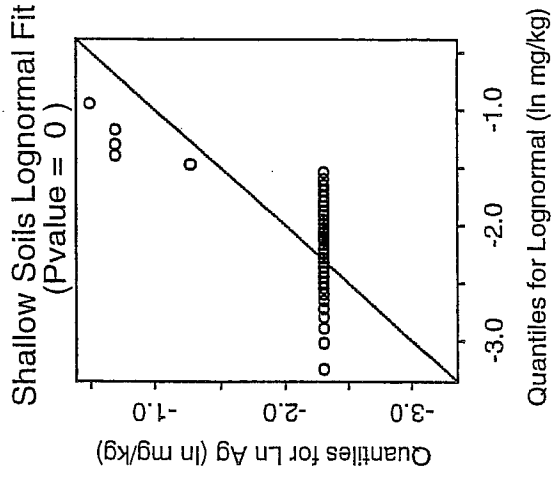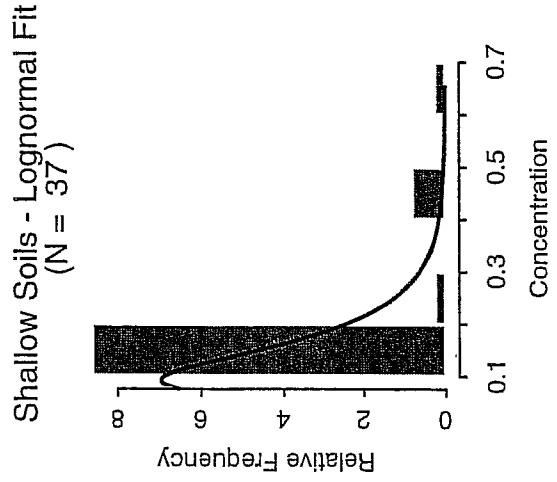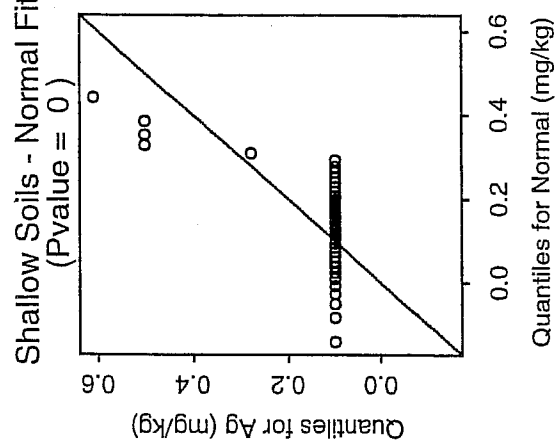Baseline 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Del Amo Site
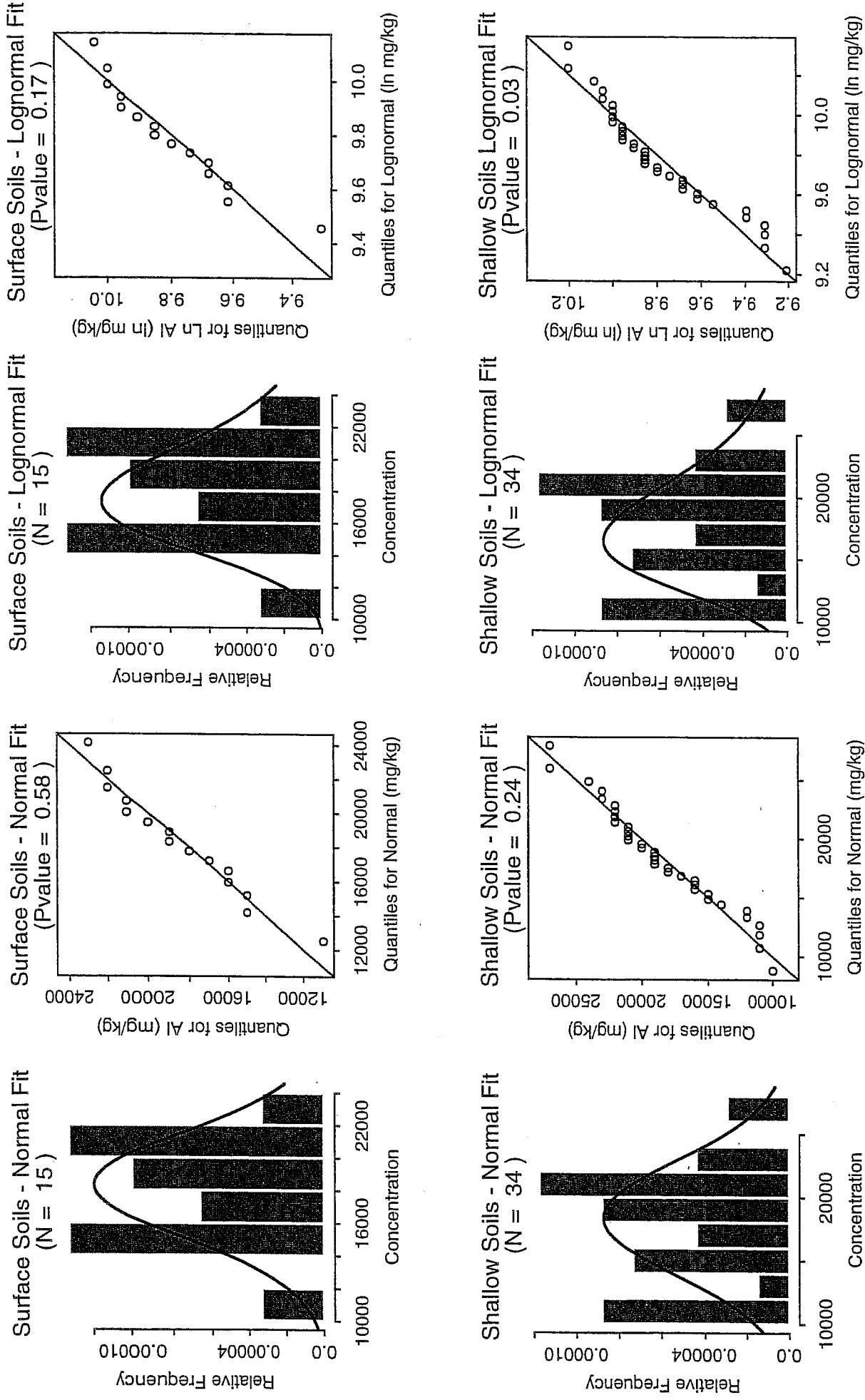
Figure B.2
Shapiro-Wilk Distribution Tests for Arsenic Baseline Risk Assessment Del Amo Site
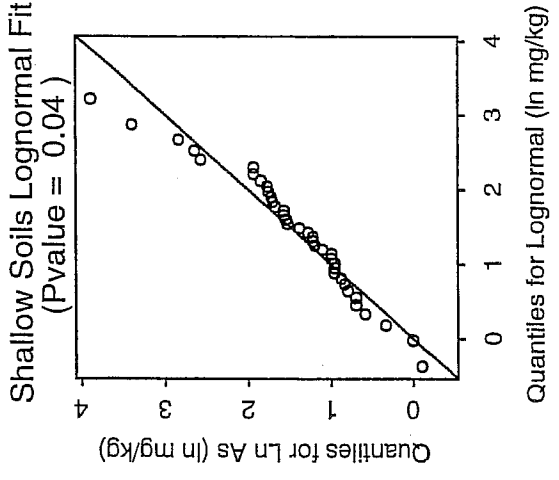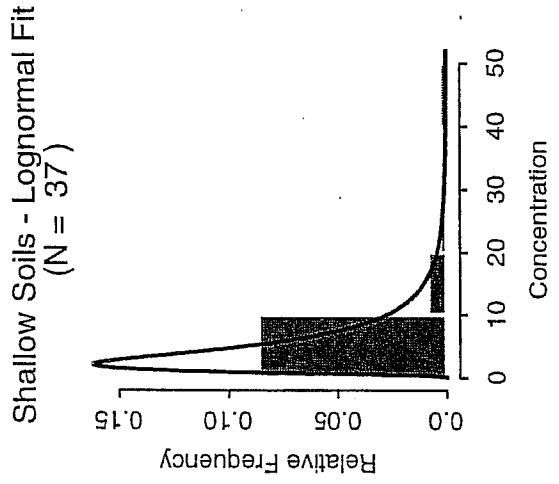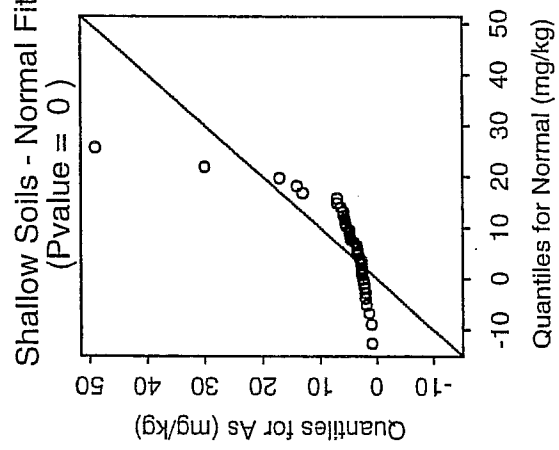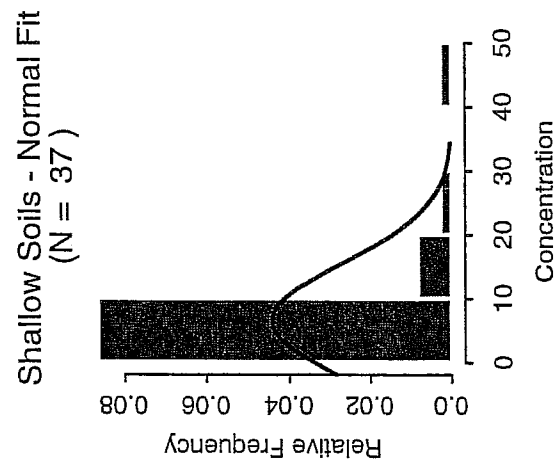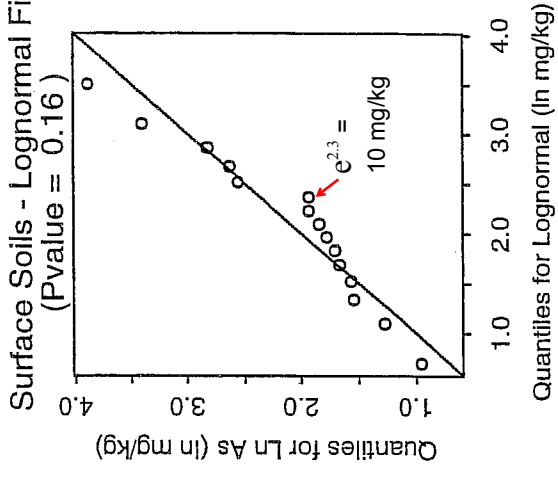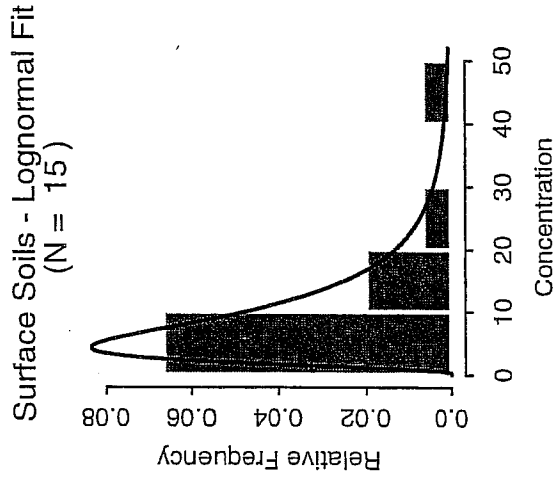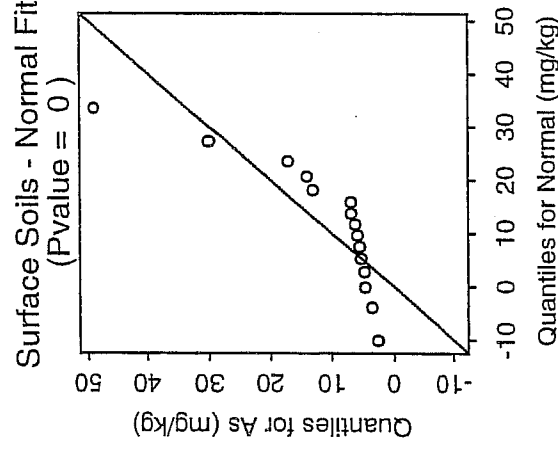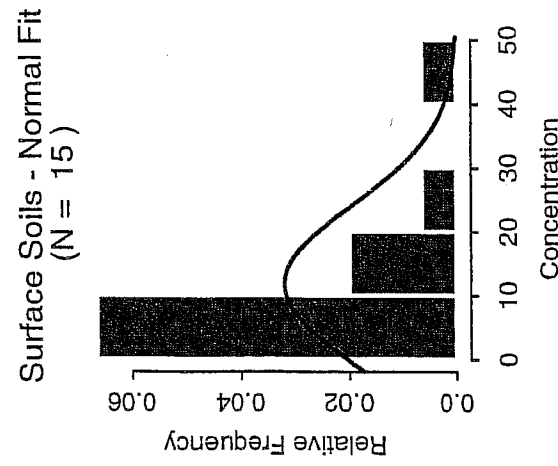
Figure B.3
Shapiro-Wilk Distribution Tests for Barium
Baseline Risk Assessment
Del Amo Site
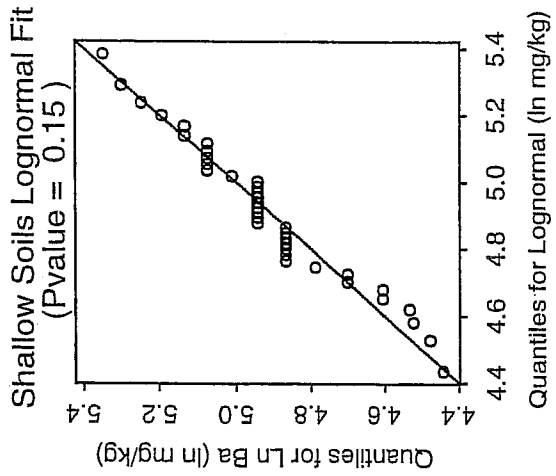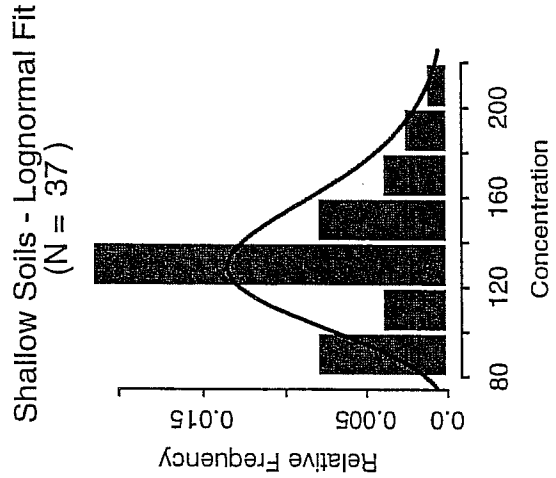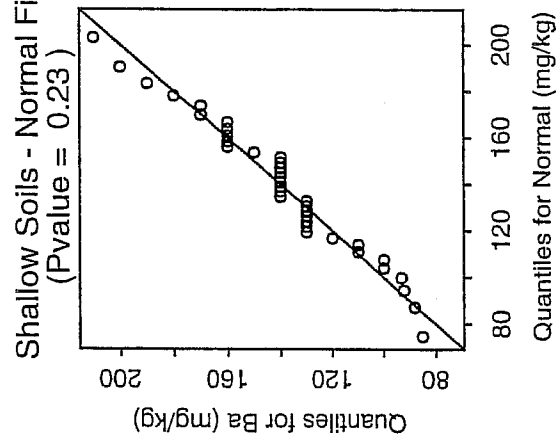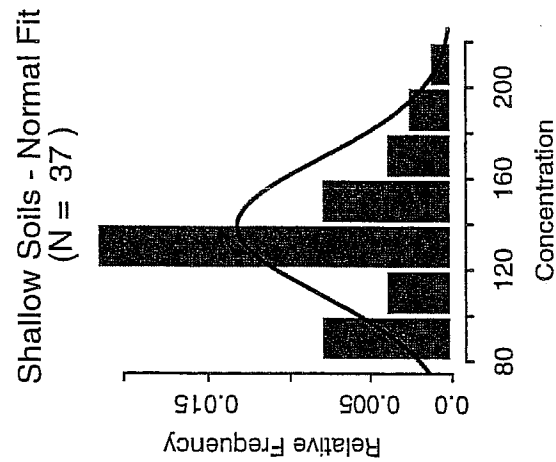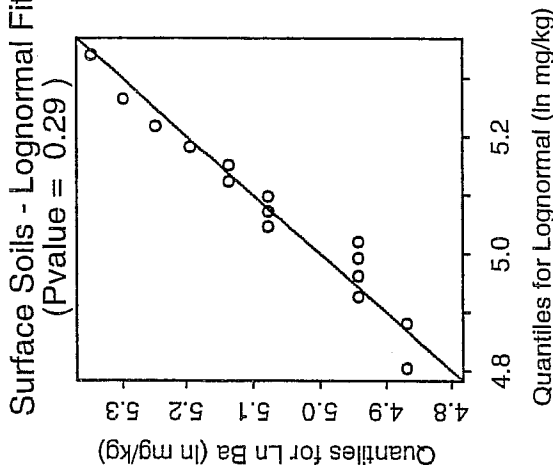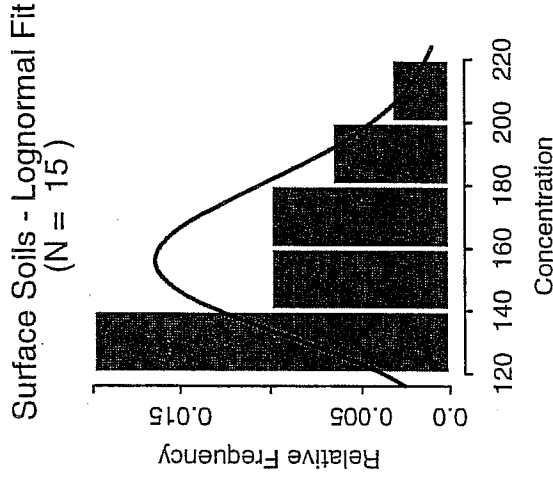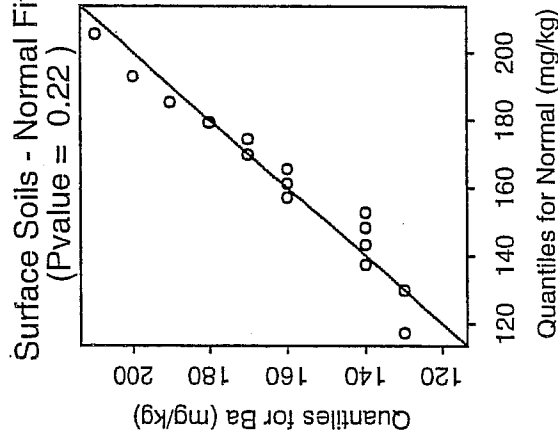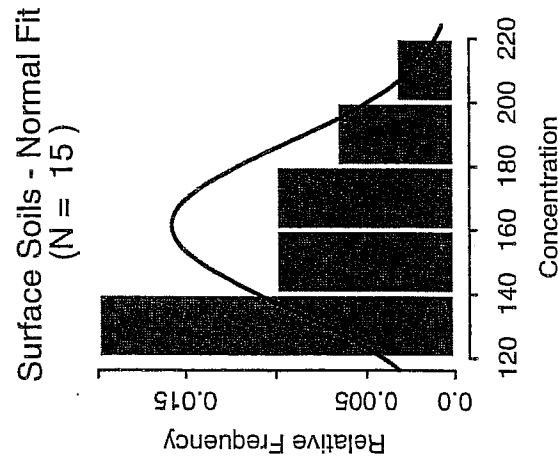
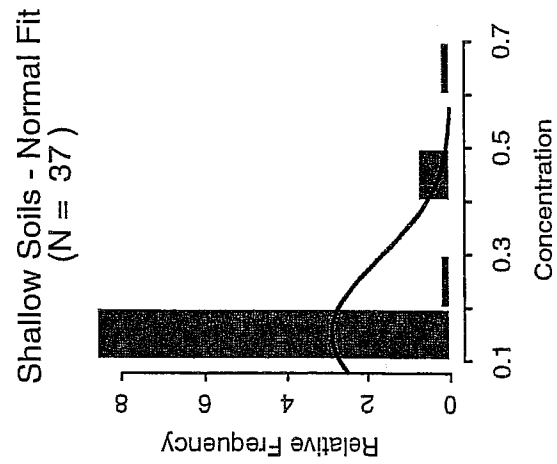Figure B.4
Shapiro-Wilk Distribution Tests for Beryllium
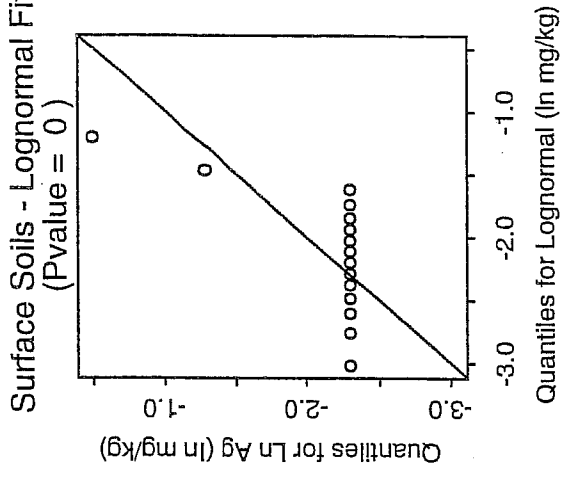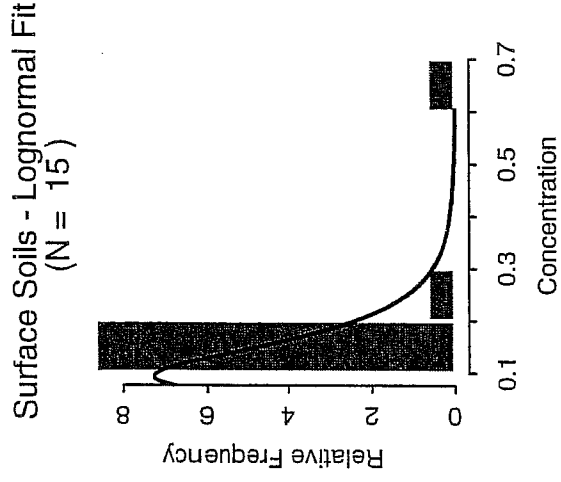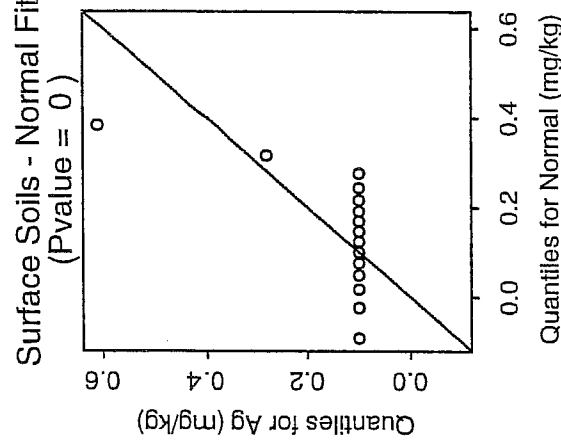Baseline Risk Assessment
Del Amo Site
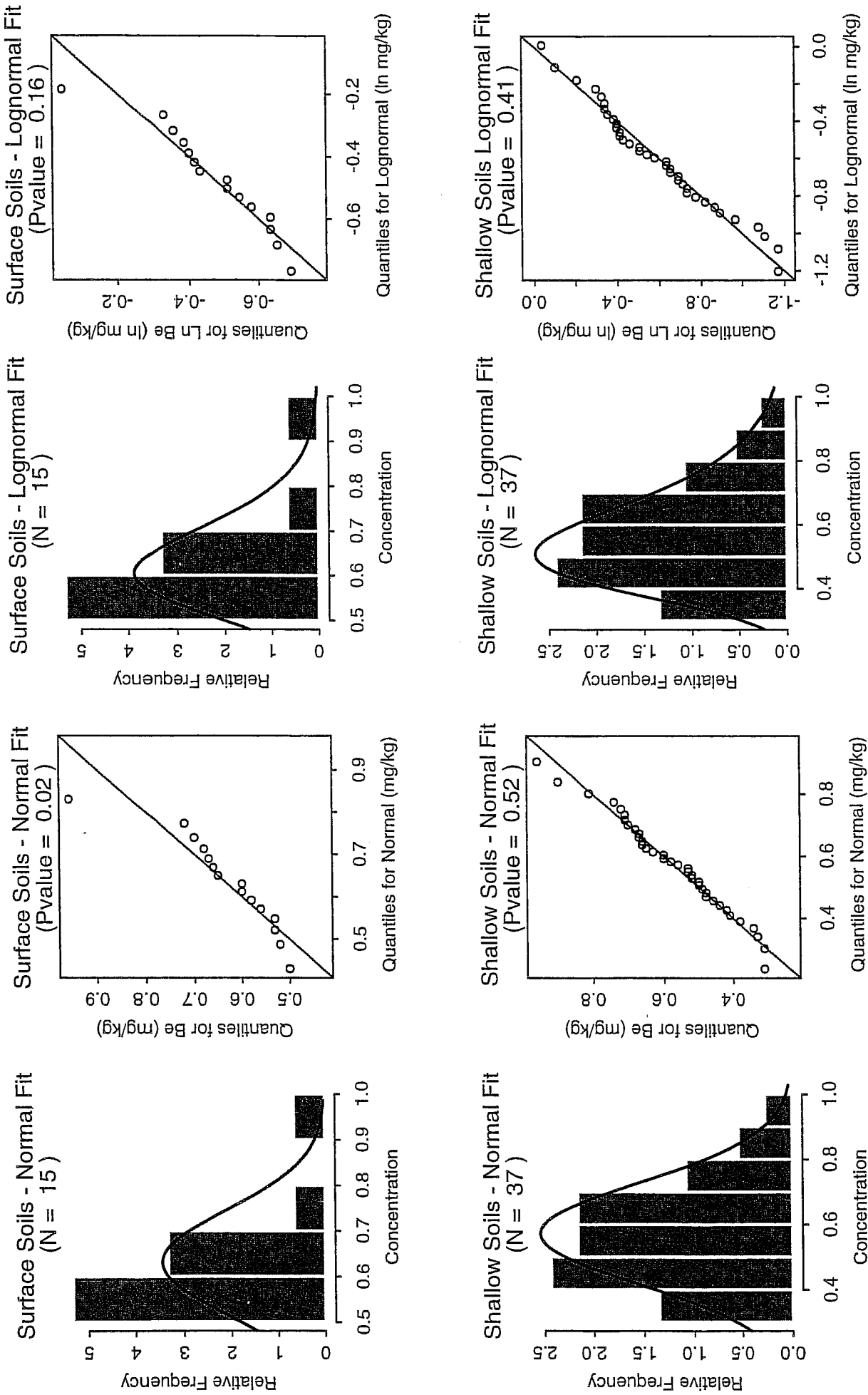
Figure B.5
Shapiro-Wilk Distribution Tests for Cadmium
Baseline Risk Assessment
Del Amo Site
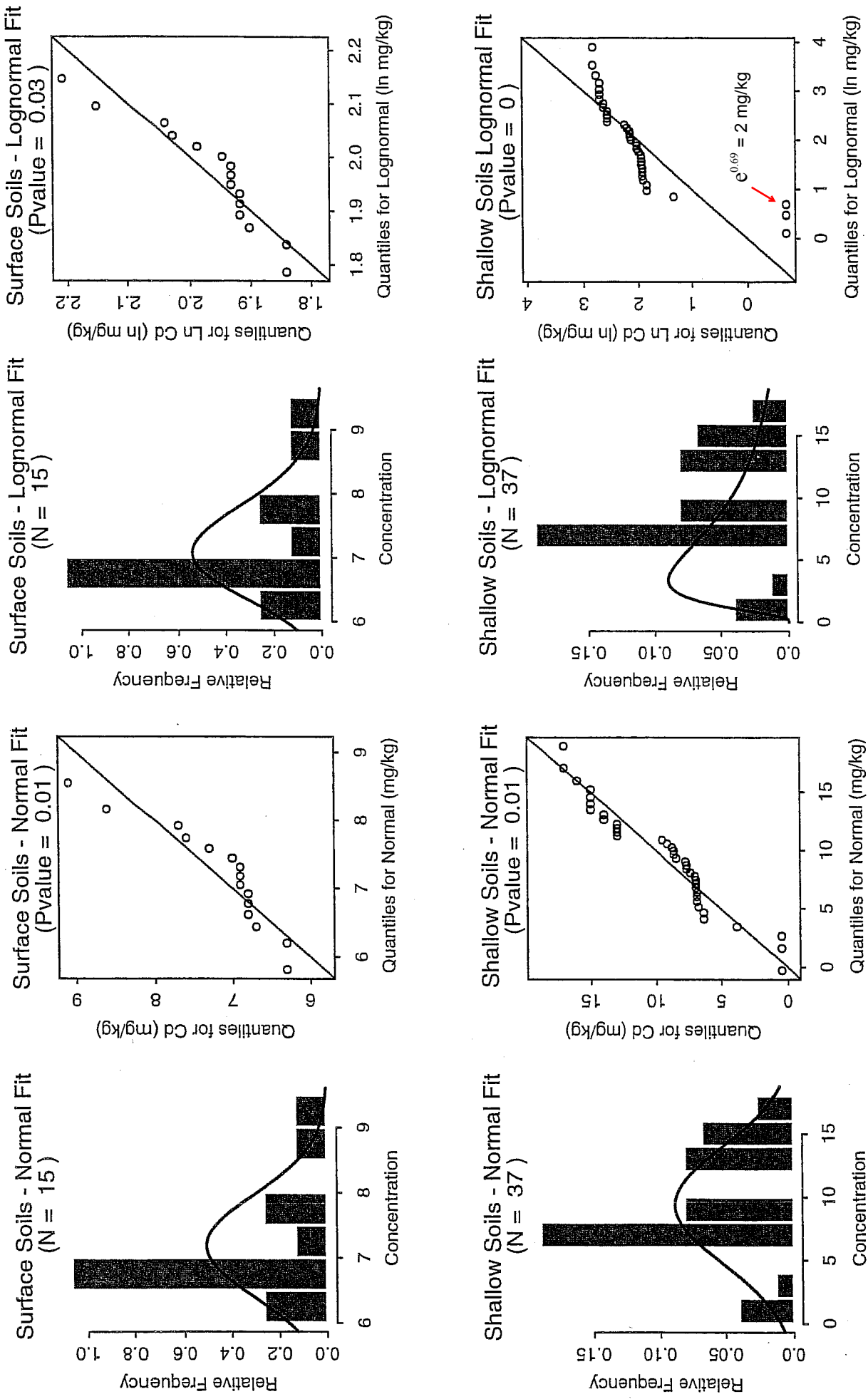
Figure B.6
Shapiro-Wilk Distribution Tests for Calcium
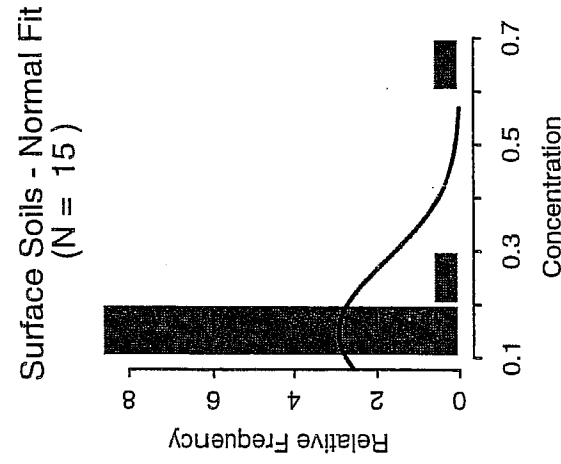Baseline Risk Assessment
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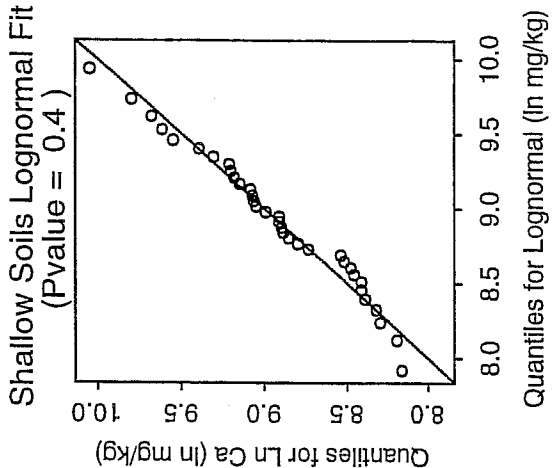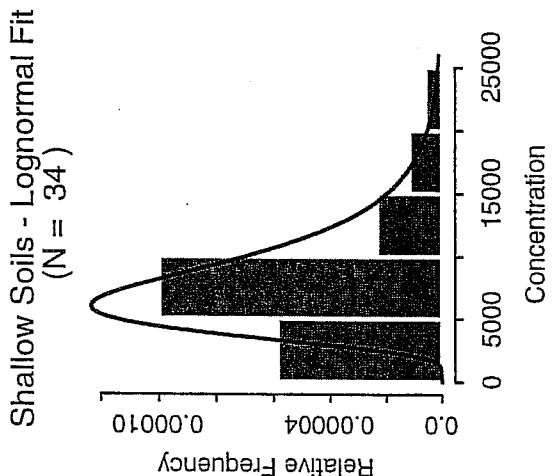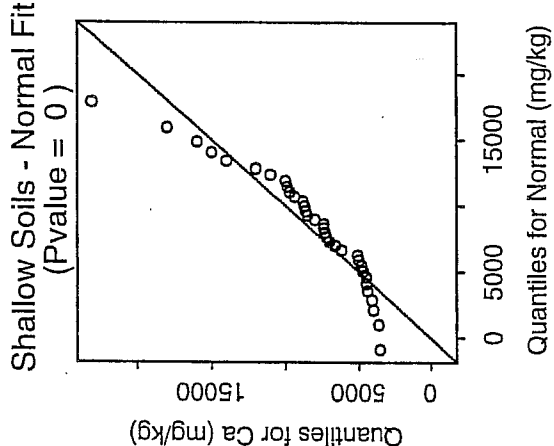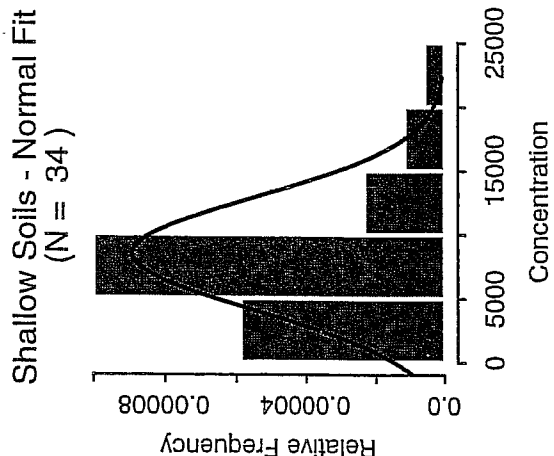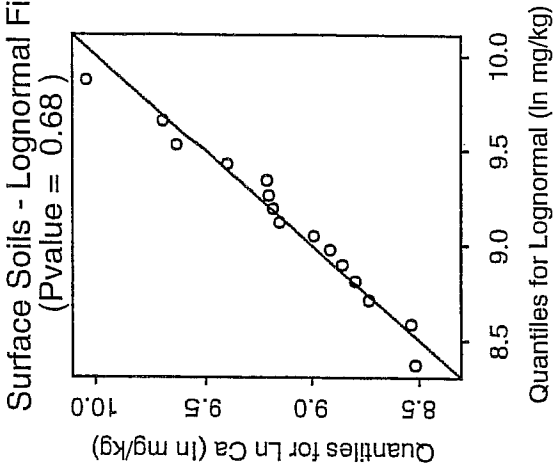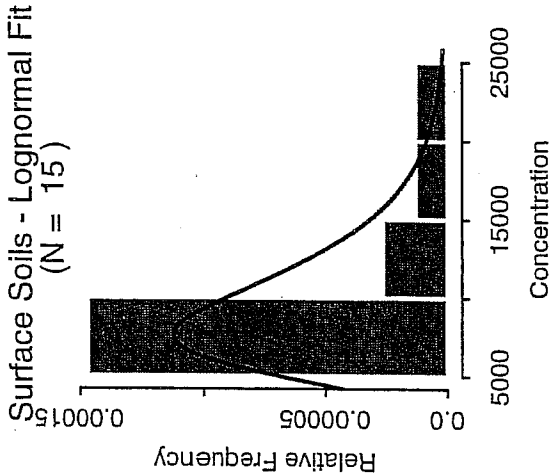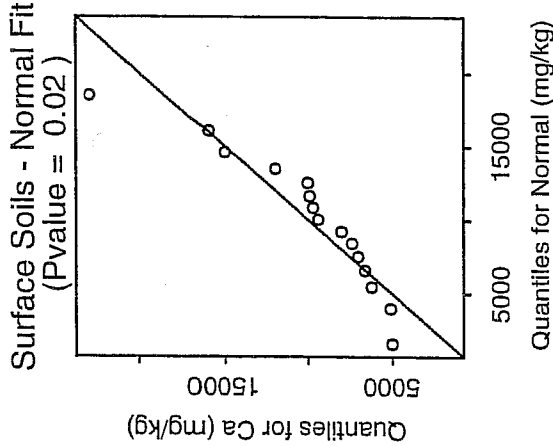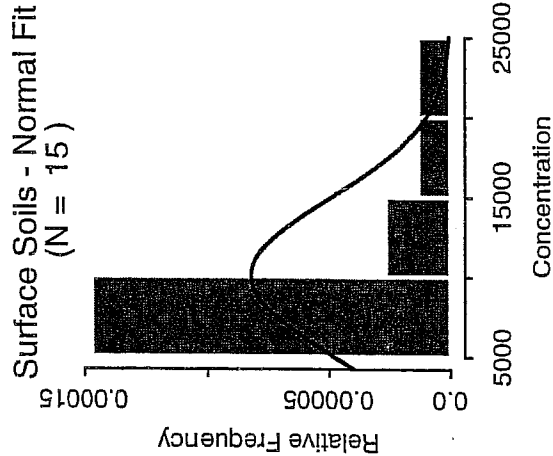
Figure B.7
Shapiro-Wilk Distribution Tests for Chromium
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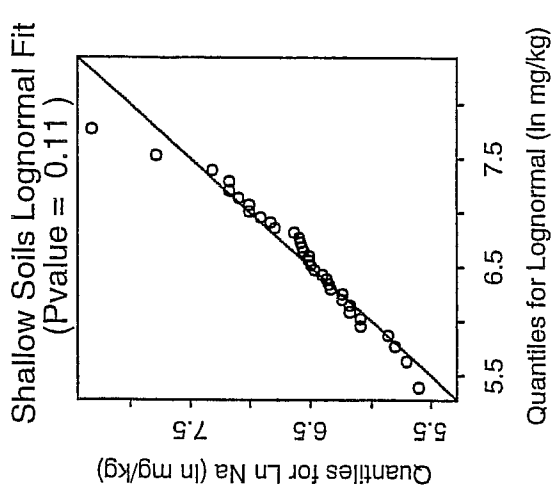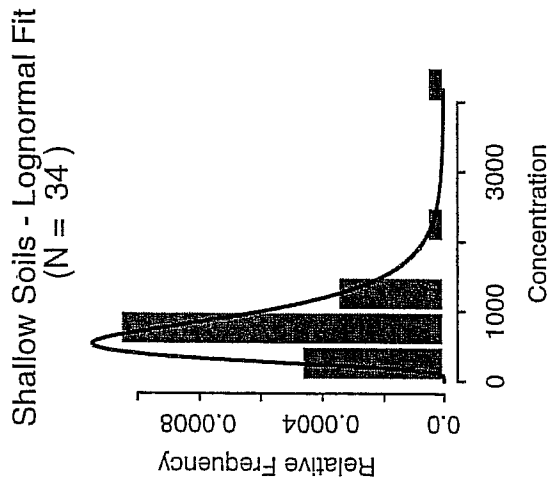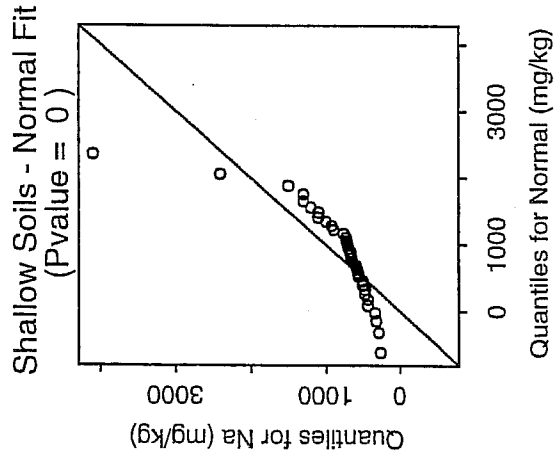Del Amo Site
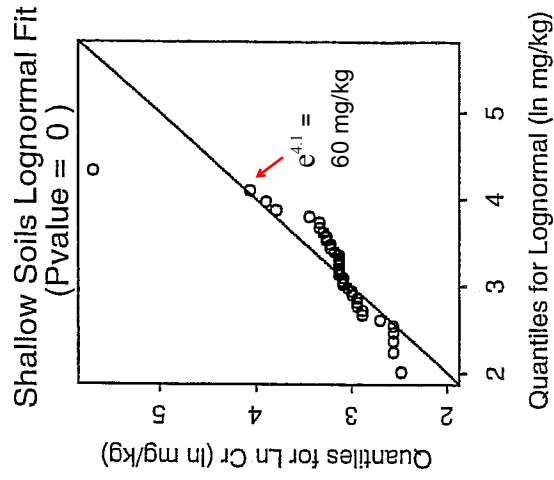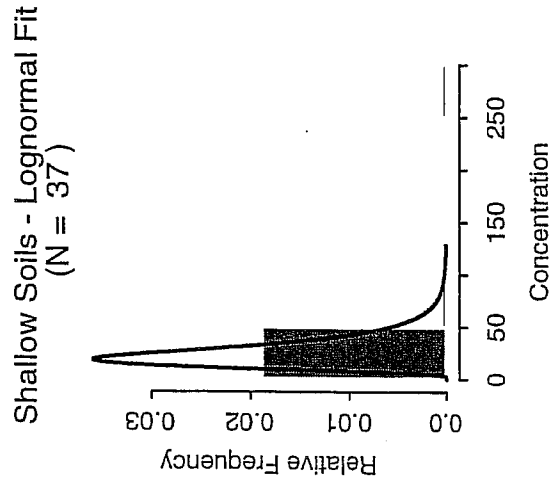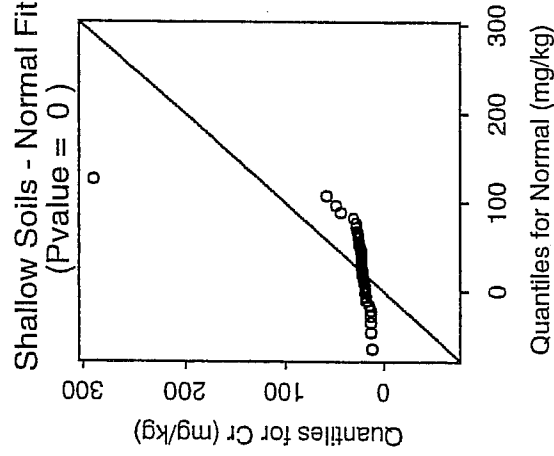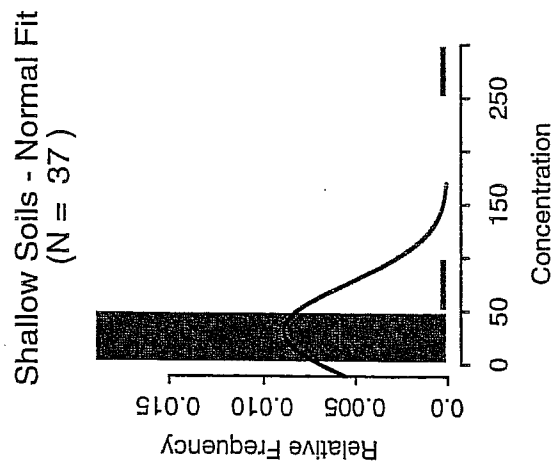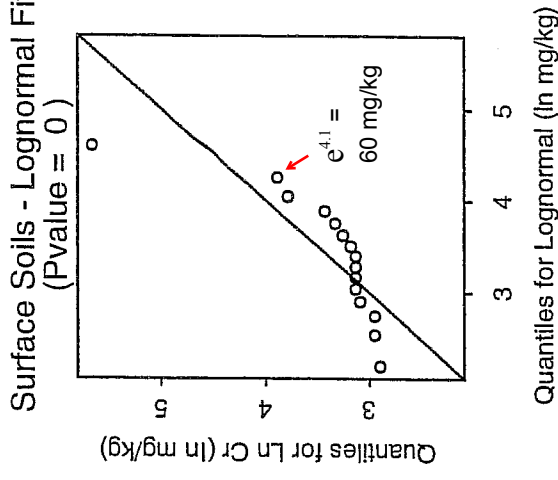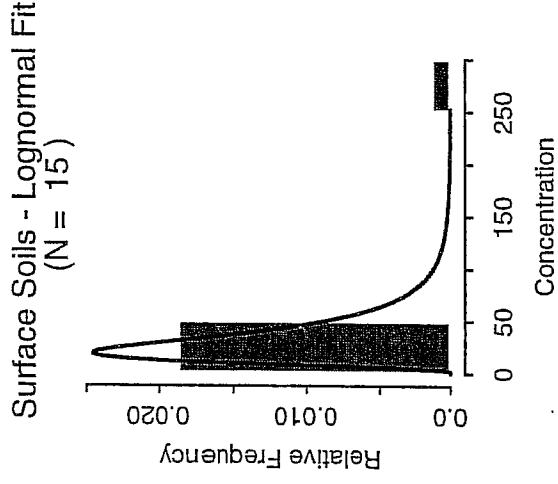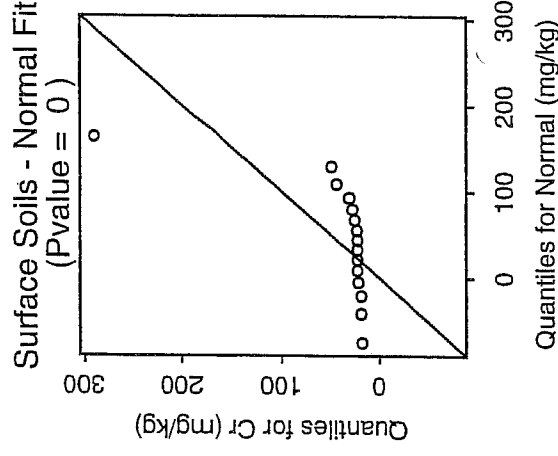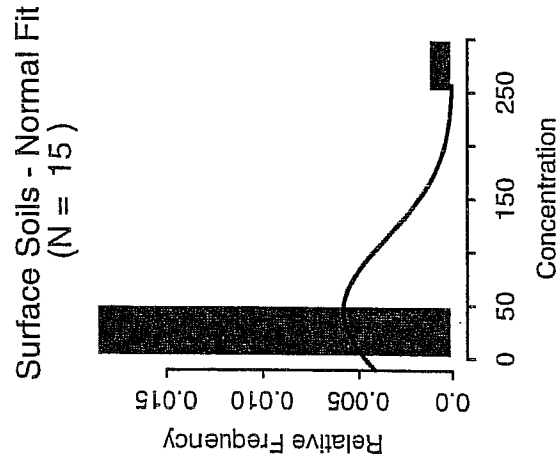
Figure B.8
Shapiro-Wilk Distribution Tests for Cobalt
Baseline Risk Assessment
Del Amo Site
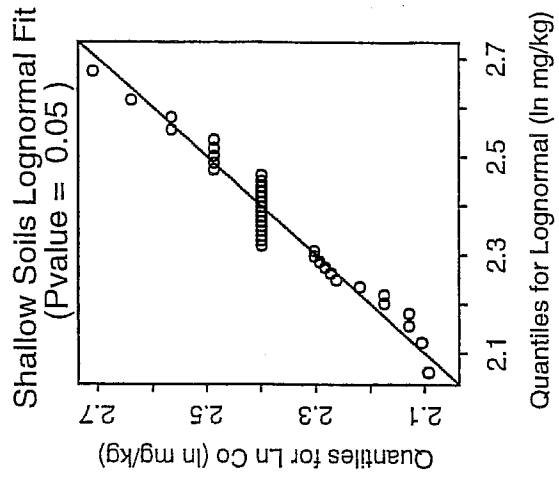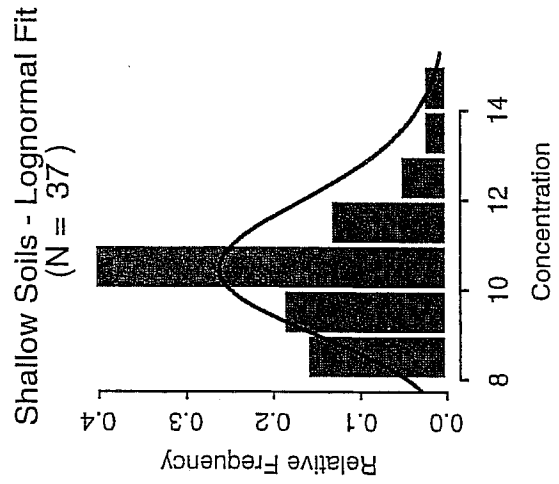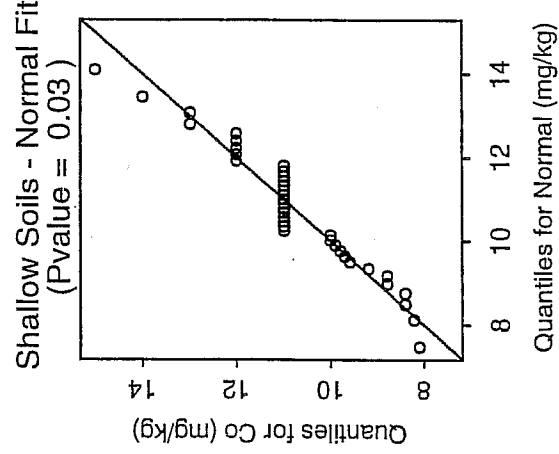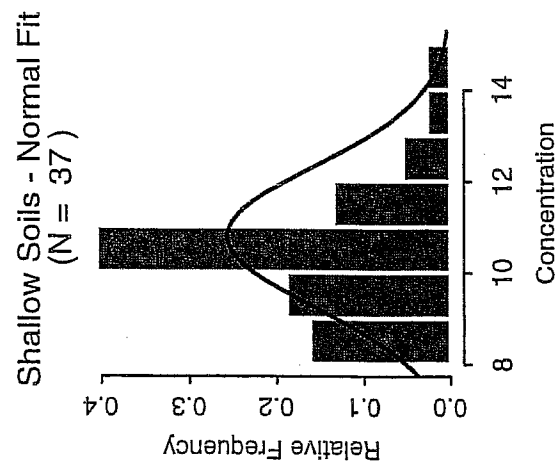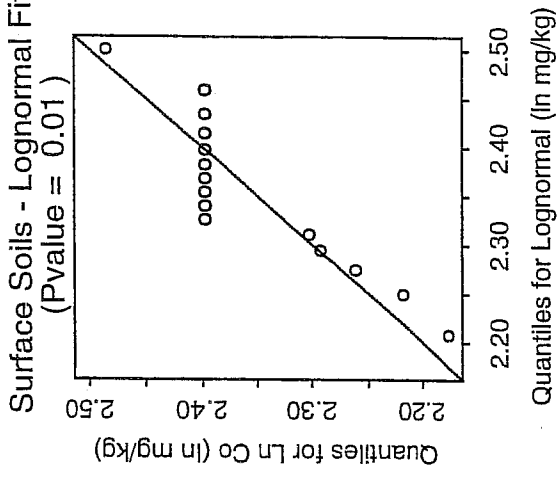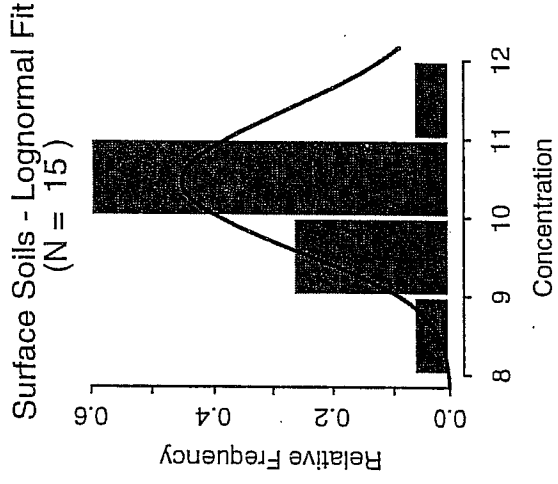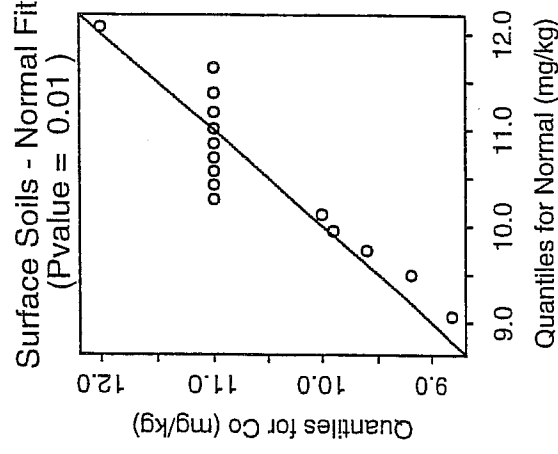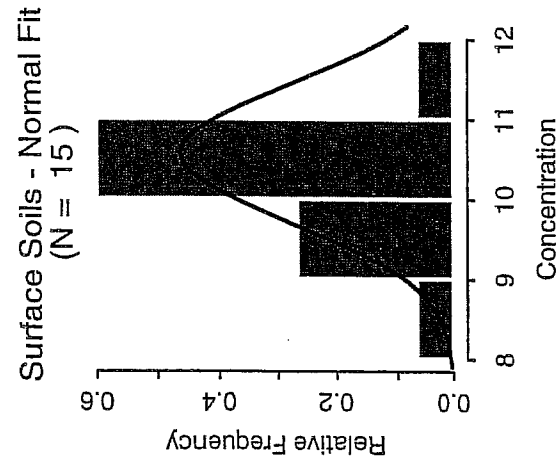
Figure B.9
Shapiro-Wilk Distribution Tests for Copper
Baseline Risk Assessment
Del Amo Site
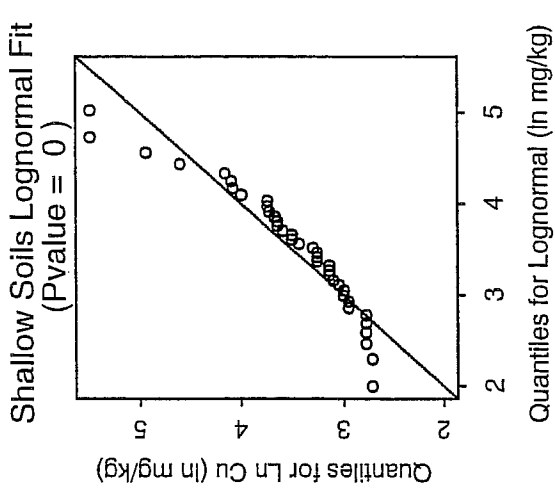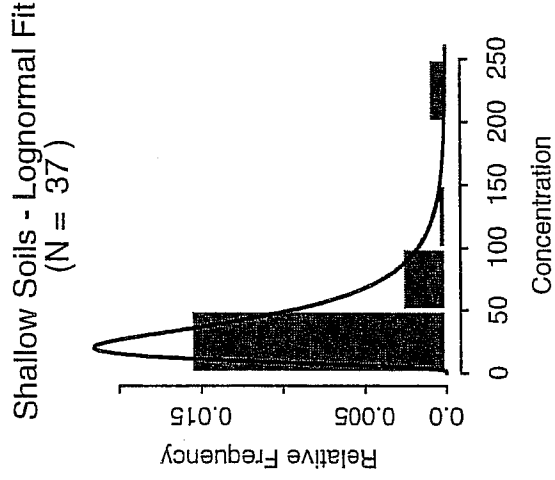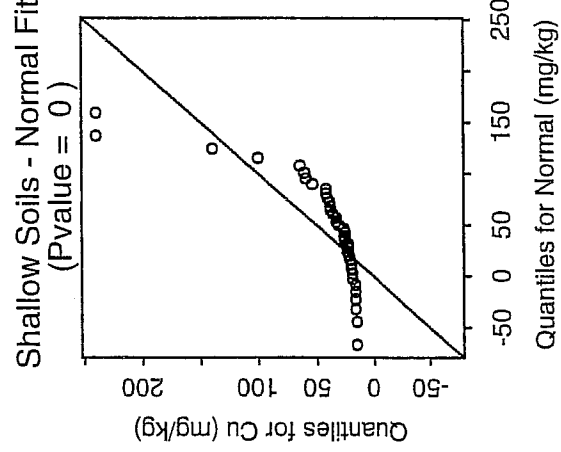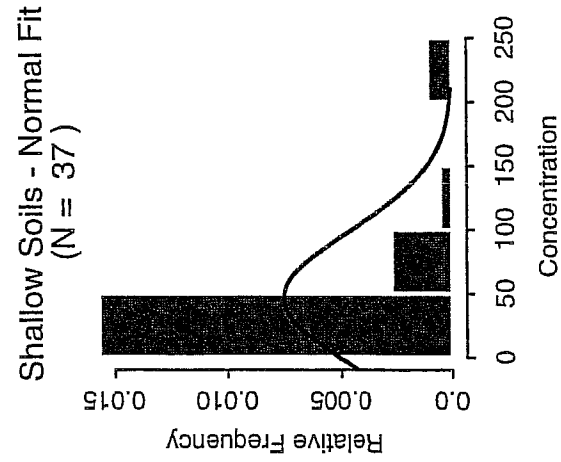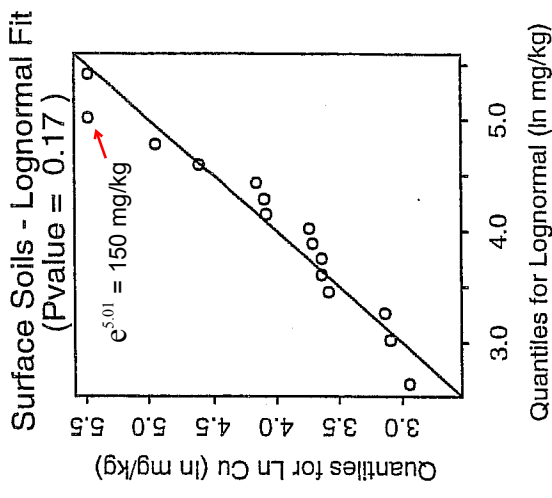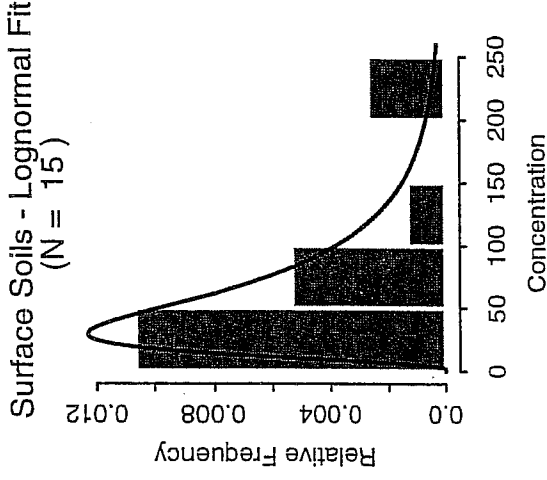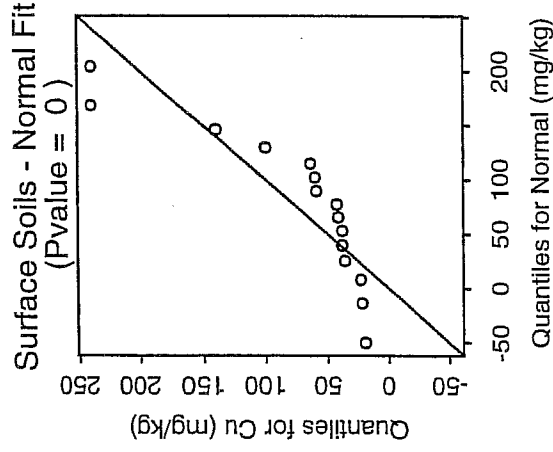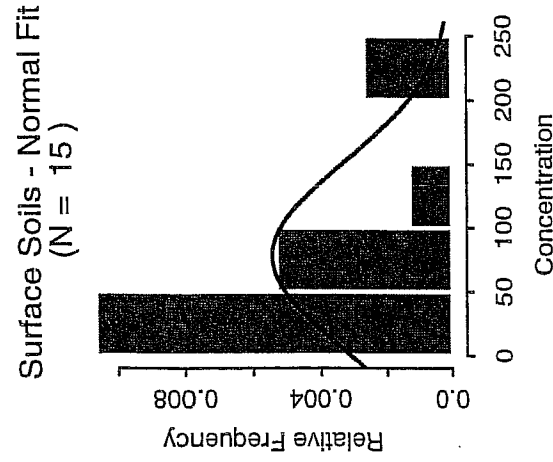
Figure B.10
Shapiro-Wilk Distribution Tests for Iron
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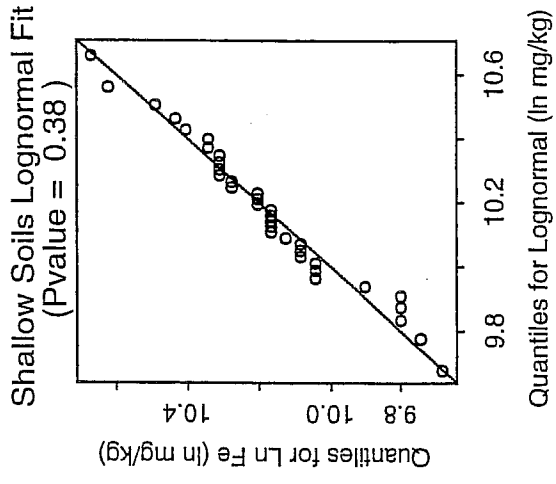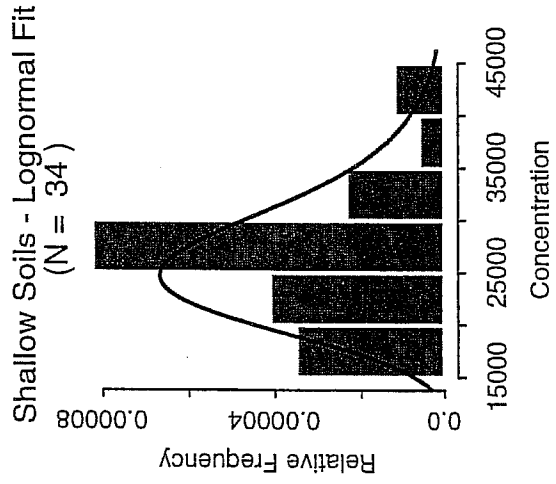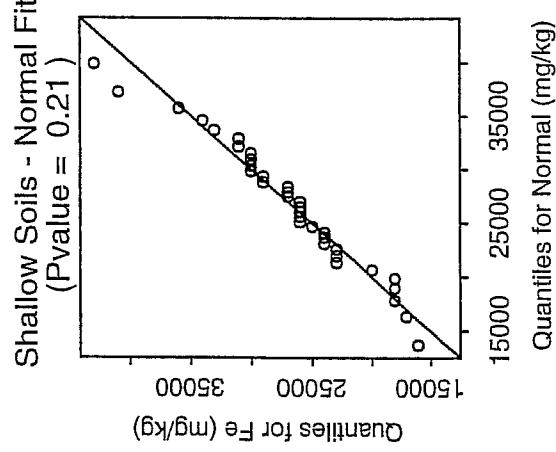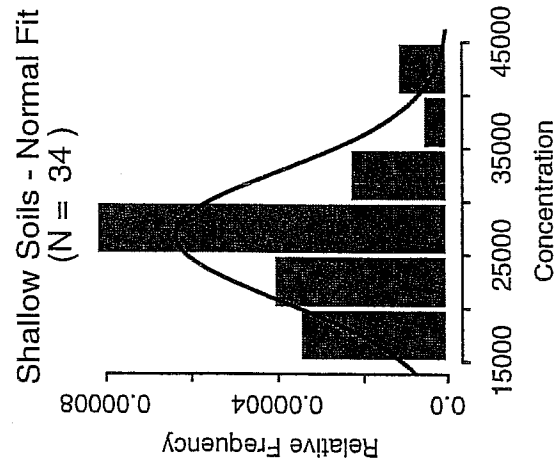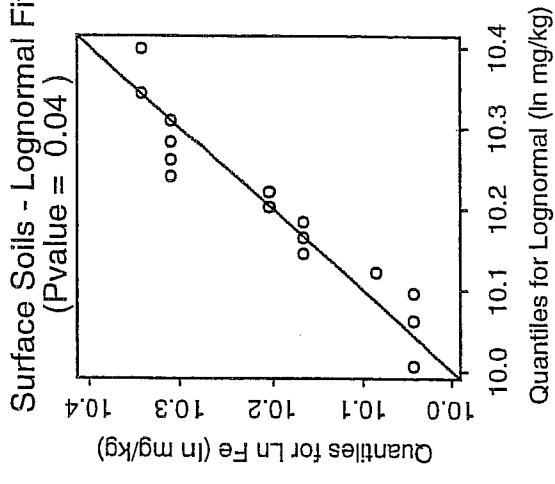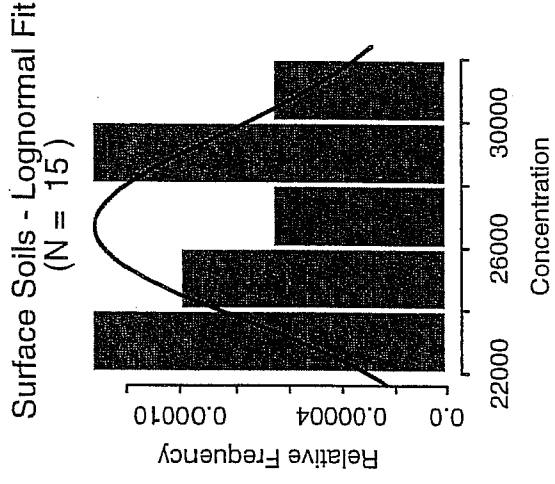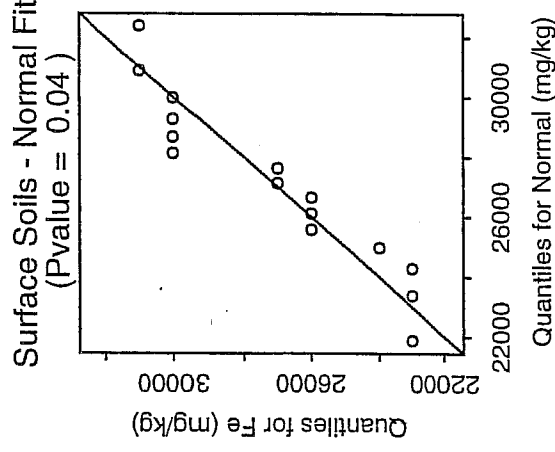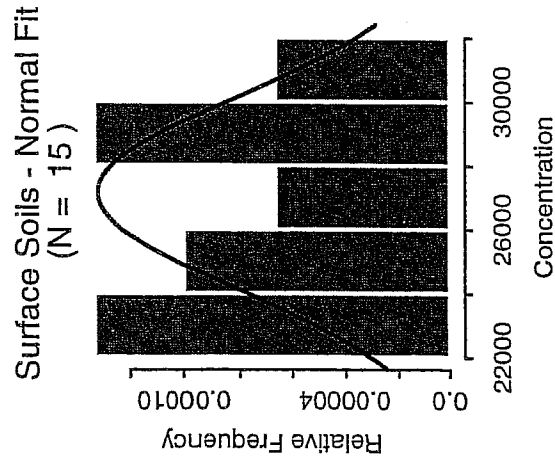
Figure B.11
Shapiro-Wilk Distribution Tests for Lead
Baseline Risk Assessment
Del Amo Site
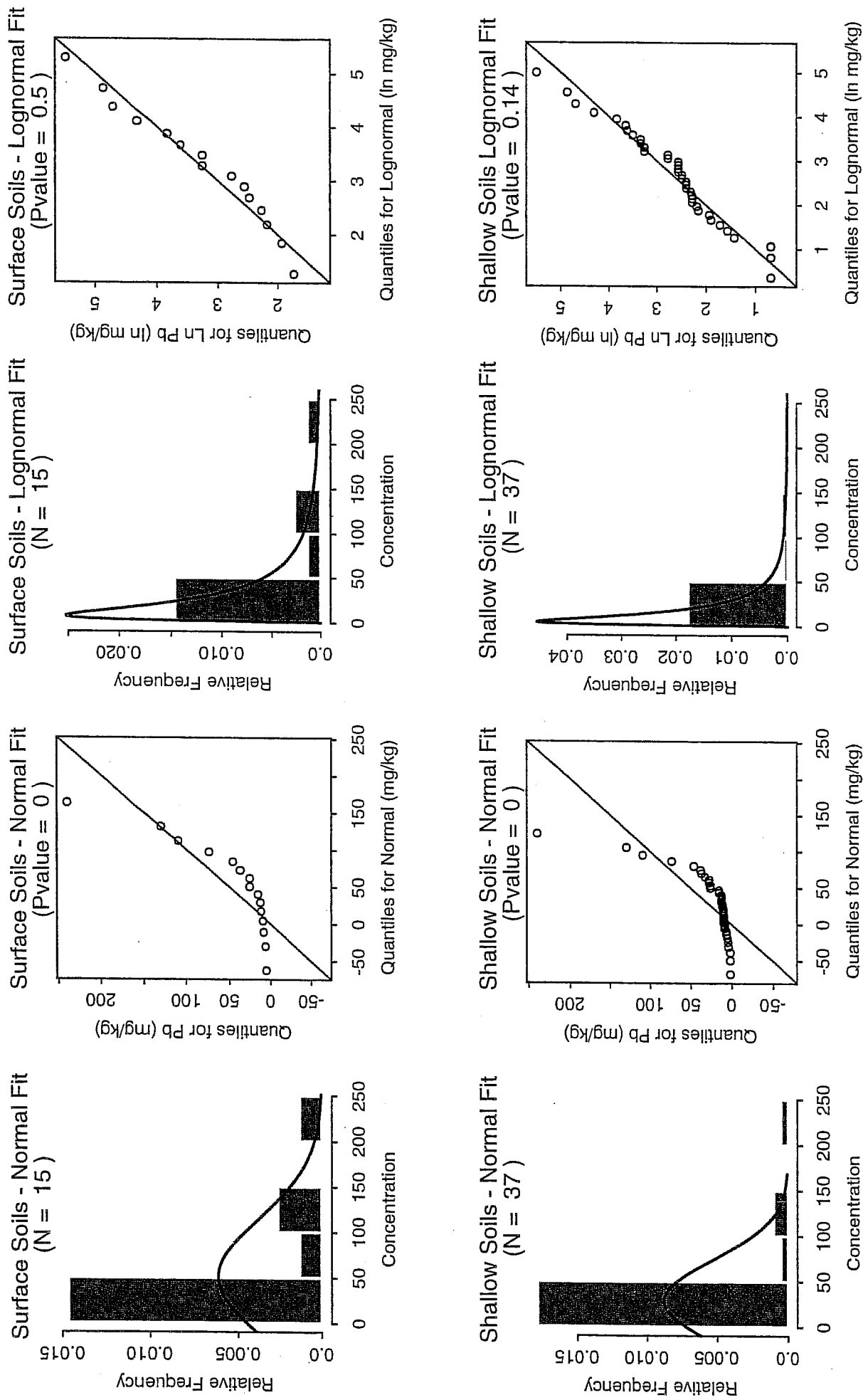
Figure B.12
Shapiro-Wilk Distribution Tests for Magnesium
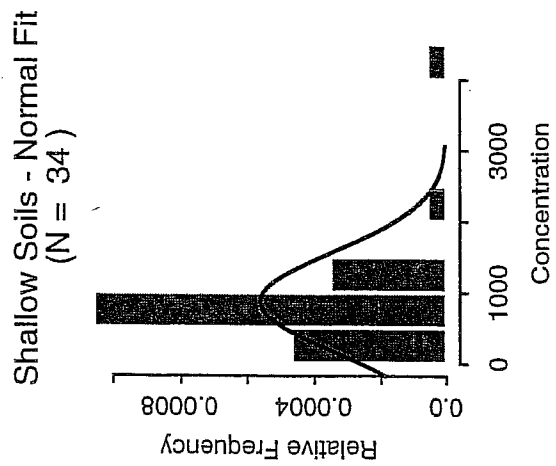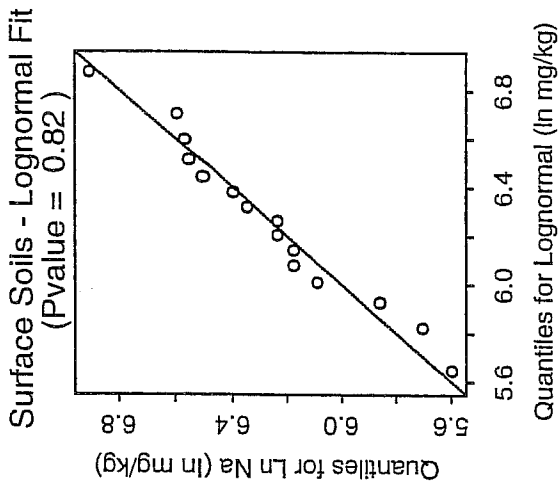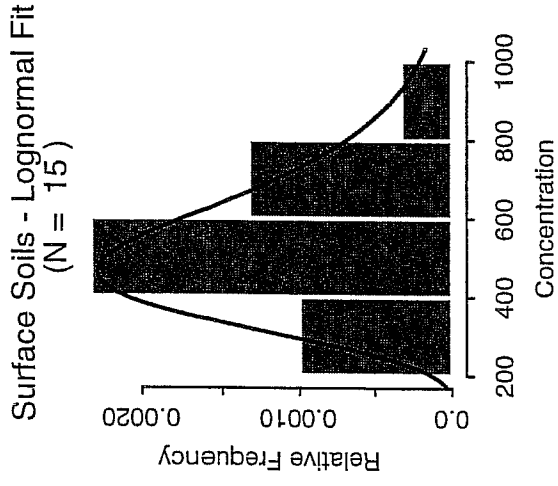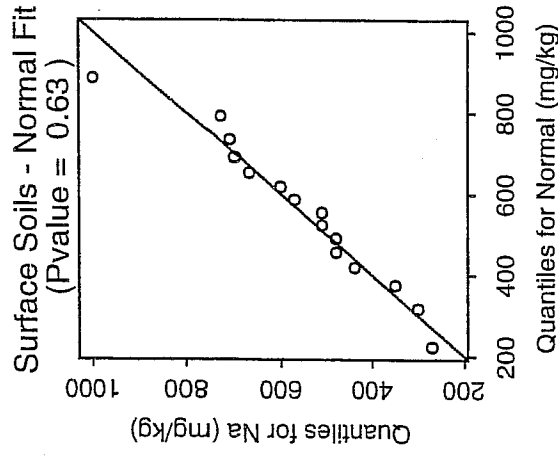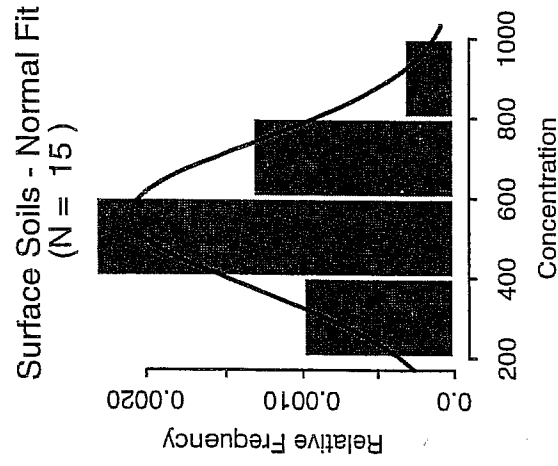Baseline Risk Assessment
Del Amo Site
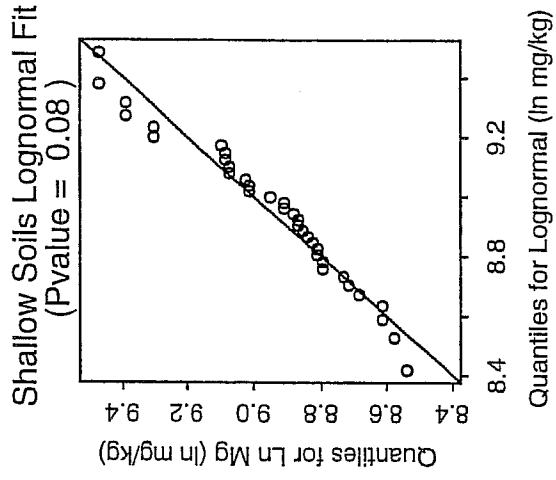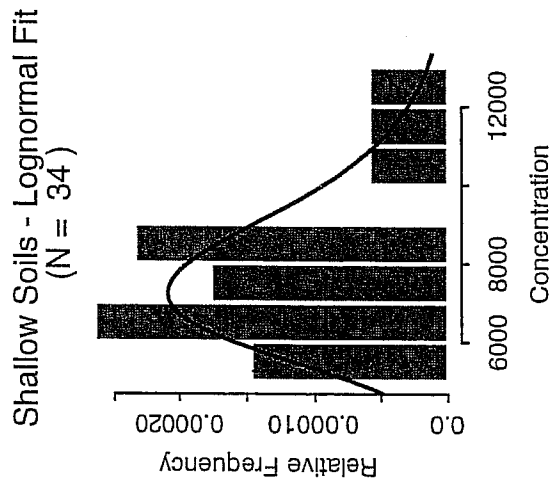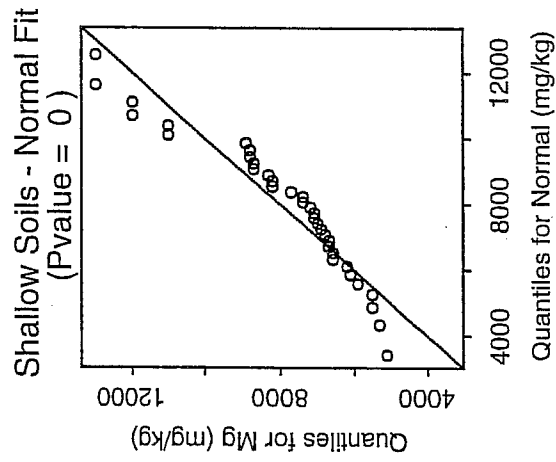
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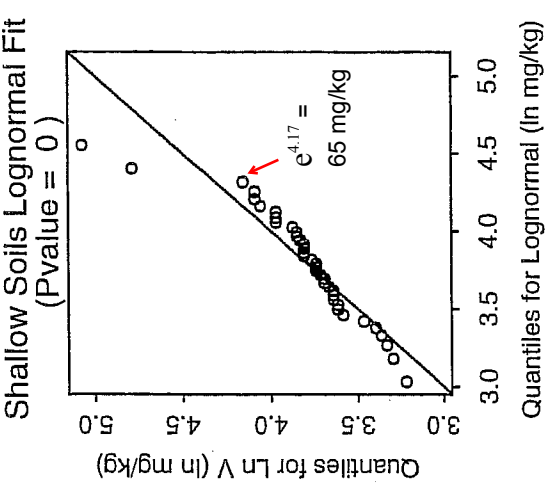Shapiro-Wilk Distribution Tests for Manganese
Baseline Risk Assessment
Del Amo Site

Figure B.14
Shapiro-Wilk Distribution Tests for Mercury
Baseline Risk Assessment
Del Amo Site

Figure B.15
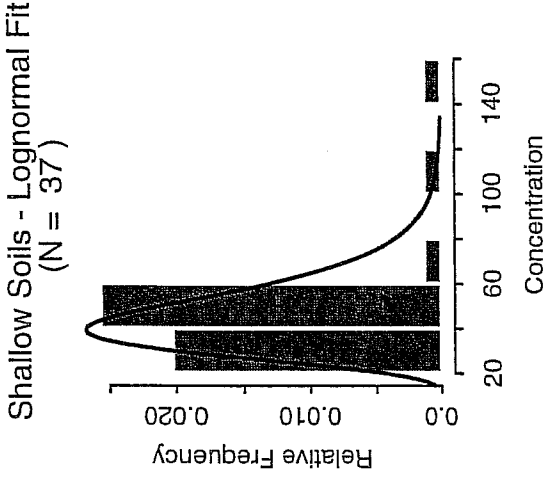Shapiro-Wilk Distribution Tests for Nickel
Baseline Risk Assessment
Del Amo Site

Figure B.16
Shapiro-Wilk Distribution Tests for Potassium
Baseline Risk Assessment
Del Amo Site

Figure B.17
Shapiro-Wilk Distribution Tests for Silver
Baseline Risk Assessment
Del Amo Site

Figure B.18
Shapiro-Wilk Distribution Tests for Sodium
Baseline Risk Assessment
Del Amo Site

Figure B.19
Shapiro-Wilk Distribution Tests for Vandadium
Baseline Risk Assessment
Del Amo Site

Figure B.20
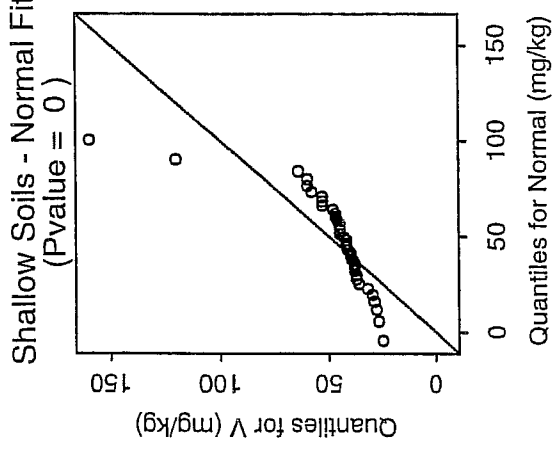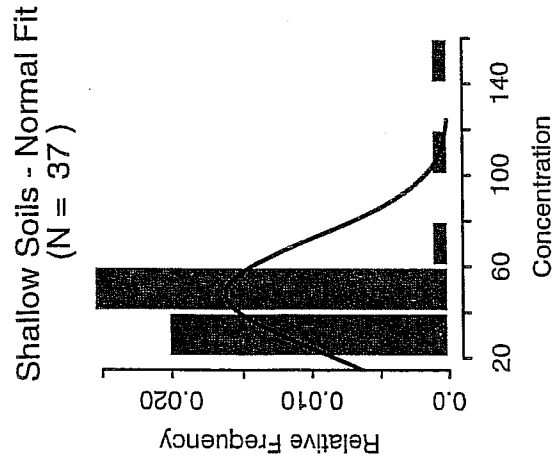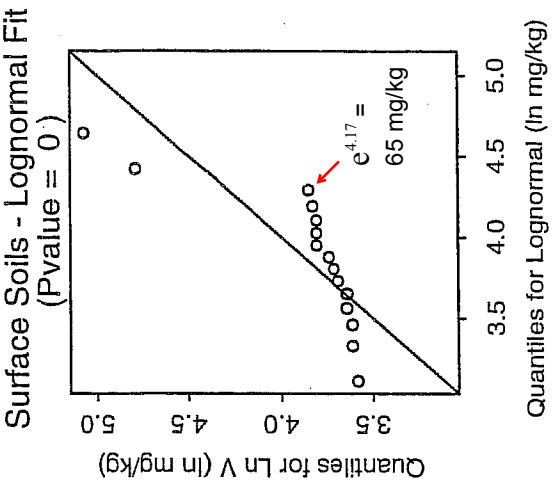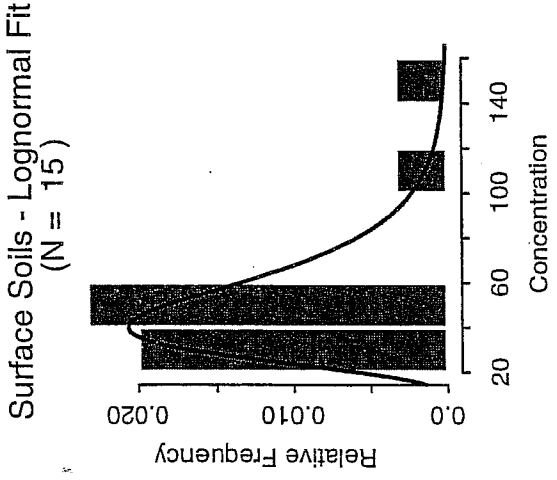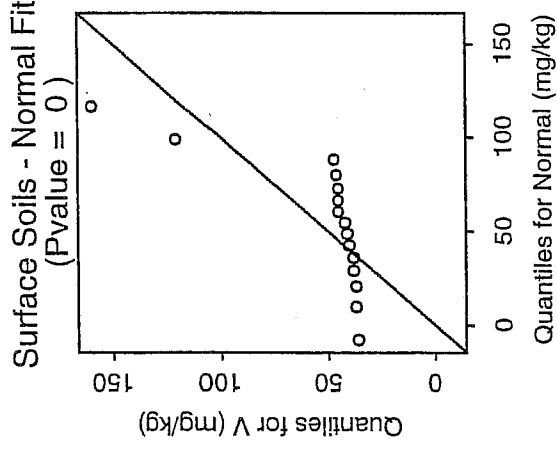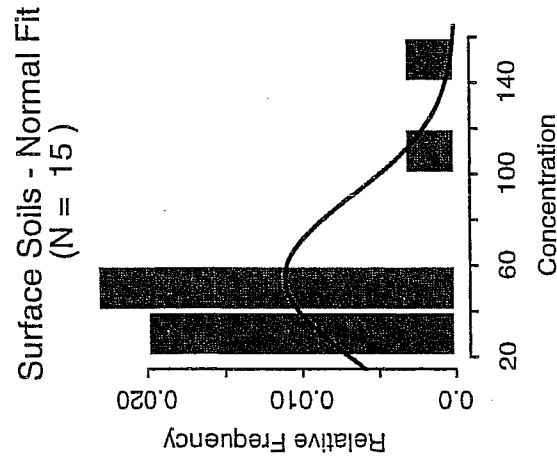Shapiro-Wilk Distribution Tests for Zinc
Baseline Risk Assessment
Del Amo Site